



Catalyst 6500 Series Switch Module Installation Guide

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Preface xi

Audience	xi
Organization	xii
Conventions	xii
Statement 1071—Warning Definition	xiv
Related Documentation	xix
Obtaining Documentation	xix
Cisco.com	xx
Documentation CD-ROM	xx
Ordering Documentation	xx
Documentation Feedback	xxi
Obtaining Technical Assistance	xxi
Cisco TAC Website	xxii
Opening a TAC Case	xxii
TAC Case Priority Definitions	xxiii
Obtaining Additional Publications and Information	xxiii

CHAPTER 1

Product Overview 1-1

Catalyst 6000 Series Switches	1-2
Catalyst 6500 Series Switches	1-4
Supervisor Engines	1-8
LEDs	1-12
RESET Button	1-13
CONSOLE Port	1-13

CONSOLE PORT MODE Switch	1-14
Switch Load	1-15
PCMCIA Slot	1-15
Uplink Ports	1-15
10/100 and 10/100/1000 Ethernet Switching Modules	1-16
24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT)	1-20
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX)	1-21
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX)	1-21
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V)	1-22
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)	1-23
24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)	1-24
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45)	1-25
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL)	1-25
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)	1-26
24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)	1-26
24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)	1-27
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V)	1-28
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)	1-29
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)	1-30
24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)	1-31
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX)	1-31

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX)	1-32
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21)	1-33
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45)	1-34
48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX)	1-35
Gigabit Ethernet Switching Modules	1-36
16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)	1-38
8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)	1-38
8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)	1-39
16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)	1-40
16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)	1-41
1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)	1-41
1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE)	1-42
16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)	1-42
16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)	1-43
16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)	1-44
4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)	1-44
24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)	1-45
16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)	1-46
Ethernet Module LEDs	1-47
ATM Modules	1-48
1-Port OC-12 ATM Module (WS-X6101-OC12-MMF)	1-49
1-Port OC-12 ATM Module (WS-X6101-OC12-SMF)	1-50
ATM Module LEDs	1-51
FlexWAN Module (WS-X6182-2PA)	1-52
Multilayer Switch Module (WS-X6302-MSM)	1-54

Network Analysis Modules	1-58
Network Analysis Module (WS-SVC-NAM-1)	1-59
Network Analysis Module (WS-SVC-NAM-2)	1-61
Firewall Services Module (WS-SVC-FWM-1-K9)	1-63
IPSec VPN Acceleration Services Module (WS-SVC-IPSEC-1)	1-66
Intrusion Detection System Module (WS-X6381-IDS)	1-68
Content Switching Module (WS-X6066-SLB-APC)	1-71
Switch Fabric Modules	1-72
Switch Fabric Module (WS-C6500-SFM)	1-72
Switch Fabric Module 2 (WS-X6500-SFM2)	1-73
Voice-Related Modules	1-75
Communications Media Module (WS-SVC-CMM)	1-75
8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1)	1-80
24-Port FXS Analog Interface Module (WS-X6624-FXS)	1-82
Port Addresses	1-84
Physical Interface Addresses	1-85
MAC Addresses	1-86
Hot Swapping Supervisor Engines and Switching Modules	1-87
Power Management and Environmental Monitoring	1-88

CHAPTER 2

Preparing for Installation 2-1

Limiting Connection Distances	2-1
Determining Cable Distances	2-2
ATM	2-3
Ethernet and Fast Ethernet	2-4
Gigabit Ethernet	2-5
10-Gigabit Ethernet	2-7

Patch Cord	2-9
Differential Mode Delay	2-11
Console Port Cabling Specifications—Supervisor Engine Only	2-13
Port Connector Requirements—Switching Modules Only	2-14
Port Densities	2-16
Gigabit Interface Converters	2-18
WS-G5483 Copper GBIC	2-19
WS-G5484, WS-G5486, and WS-G5487 Optical GBICs	2-20
Coarse Wave Division Multiplexing GBICs	2-21
SFP Optical Transceiver Modules	2-22
1000BASE-T SFP Modules	2-23
CWDM SFP Optical Transceiver Modules	2-24
XenPak Optical Transceiver Modules	2-25
Software Requirements	2-26

CHAPTER 3**Installing the Module 3-1**

Required Tools	3-2
Installing a Supervisor Engine or a Switching Module	3-2
Removing the Supervisor Engine or a Switching Module	3-12
Connecting to the Console Port—Supervisor Engine Only	3-15
Connecting a Terminal	3-15
Connecting a Modem	3-16
Connecting to the Uplink Ports—Supervisor Engine Only	3-16
Using Flash PC Cards	3-17
Installing and Removing a Flash PC Card	3-19
Verifying the Installation	3-19
Verifying Newly Installed Modules	3-20
Checking Connectivity	3-22
What To Do After Installing Modules and Verifying Connectivity	3-22

APPENDIX A

Technical Specifications A-1

Module Specifications **A-1**

Regulatory Standards Compliance **A-2**

APPENDIX B

Cable and Connector Specifications B-1

RJ-21 Connector **B-2**

RJ-21 (WS-X6624-FXS Only) **B-4**

RJ-45 Connector **B-5**

Supervisor Engine Console Port Signals and Pinouts **B-8**

CONSOLE PORT MODE Switch **B-9**

Identifying a Rollover Cable **B-9**

Console Port Mode 1 Signaling and Pinouts **B-10**

Console Port Mode 2 Signaling and Pinouts **B-13**

Fiber-Optic Connectors **B-14**

SC Connectors **B-14**

MT-RJ Connectors **B-15**

LC Connectors **B-16**

Cleaning the Fiber-Optic Connectors **B-17**

INDEX



Preface

This preface describes who should read the *Catalyst 6500 Series Switch Module Installation Guide*, how it is organized, and its document conventions.

Audience

Only trained and qualified service personnel (as defined in IEC 60950 and AS/NZS3260) should install, replace, or service the equipment described in this publication.

Organization

This publication is organized as follows:

Chapter	Title	Description
Chapter 1	Product Overview	Provides an overview of the Catalyst 6500 series switches, the supervisor engine, Ethernet switching modules, and ATM modules.
Chapter 2	Preparing for Installation	Describes how to prepare your site before installing the supervisor engine and switching modules, and includes information on ensuring safety during installation and preparing the necessary cabling and interface connectors.
Chapter 3	Installing the Module	Describes how to install the supervisor engine, Ethernet switching modules, and ATM modules in the Catalyst 6500 series switch. Includes procedures to verify the module operation after installation.
Appendix A	Technical Specifications	Lists the technical specifications for the Catalyst 6500 series modules.
Appendix B	Cable and Connector Specifications	Lists the cable specifications for the Catalyst 6500 series modules.

Conventions

This publication uses the following conventions:

Convention	Description
boldface font	Commands, command options, and keywords are in boldface .
<i>italic</i> font	Arguments for which you supply values are in <i>italics</i> .
[]	Elements in square brackets are optional.
{ x y z }	Alternative keywords are grouped in braces and separated by vertical bars.

Convention	Description
[x y z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
screen font	Terminal sessions and information the system displays are in <code>screen font</code> .
boldface screen font	Information you must enter is in boldface screen font .
<i>italic screen font</i>	Arguments for which you supply values are in <i>italic screen font</i> .
^	The symbol ^ represents the key labeled Control. For example, the key combination ^D in a screen display means hold down the Control key while you press the D key.
< >	Nonprinting characters, such as passwords, are in angle brackets.

Notes use the following conventions:

**Note**

Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

Cautions use the following conventions:

**Caution**

Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Warnings use the following conventions:

Statement 1071—Warning Definition



Warning

IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Waarschuwing

BELANGRIJKE VEILIGHEIDSINSTRUCTIES

Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van de standaard praktijken om ongelukken te voorkomen. Gebruik het nummer van de verklaring onderaan de waarschuwing als u een vertaling van de waarschuwing die bij het apparaat wordt geleverd, wilt raadplegen.

BEWAAR DEZE INSTRUCTIES

Varoitus

TÄRKEITÄ TURVALLISUUSOHJEITA

Tämä varoitusmerkki merkitsee vaaraa. Tilanne voi aiheuttaa ruumiillisia vammoja. Ennen kuin käsittelet laitteistoa, huomioi sähköpiirien käsittelemiseen liittyvät riskit ja tutustu onnettomuuksien yleisiin ehkäisytapoihin. Turvallisuusvaroitusten käännökset löytyvät laitteen mukana toimitettujen käännettyjen turvallisuusvaroitusten joukosta varoitusten lopussa näkyvien lausuntonumeroiden avulla.

SÄILYTÄ NÄMÄ OHJEET

Attention IMPORTANTES INFORMATIONS DE SÉCURITÉ

Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers liés aux circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions des avertissements figurant dans les consignes de sécurité traduites qui accompagnent cet appareil, référez-vous au numéro de l'instruction situé à la fin de chaque avertissement.

CONSERVEZ CES INFORMATIONS**Warnung WICHTIGE SICHERHEITSHINWEISE**

Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu Verletzungen führen kann. Machen Sie sich vor der Arbeit mit Geräten mit den Gefahren elektrischer Schaltungen und den üblichen Verfahren zur Vorbeugung vor Unfällen vertraut. Suchen Sie mit der am Ende jeder Warnung angegebenen Anweisungsnummer nach der jeweiligen Übersetzung in den übersetzten Sicherheitshinweisen, die zusammen mit diesem Gerät ausgeliefert wurden.

BEWAHREN SIE DIESE HINWEISE GUT AUF.**Avvertenza IMPORTANTI ISTRUZIONI SULLA SICUREZZA**

Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

CONSERVARE QUESTE ISTRUZIONI

Advarsel VIKTIGE SIKKERHETSINSTRUKSJONER

Dette advarselssymbolet betyr fare. Du er i en situasjon som kan føre til skade på person. Før du begynner å arbeide med noe av utstyret, må du være oppmerksom på farene forbundet med elektriske kretser, og kjenne til standardprosedyrer for å forhindre ulykker. Bruk nummeret i slutten av hver advarsel for å finne oversettelsen i de oversatte sikkerhetsadvarslene som fulgte med denne enheten.

TA VARE PÅ DISSE INSTRUKSJONENE**Aviso INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você está em uma situação que poderá ser causadora de lesões corporais. Antes de iniciar a utilização de qualquer equipamento, tenha conhecimento dos perigos envolvidos no manuseio de circuitos elétricos e familiarize-se com as práticas habituais de prevenção de acidentes. Utilize o número da instrução fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham este dispositivo.

GUARDE ESTAS INSTRUÇÕES**¡Advertencia! INSTRUCCIONES IMPORTANTES DE SEGURIDAD**

Este símbolo de aviso indica peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considere los riesgos de la corriente eléctrica y familiarícese con los procedimientos estándar de prevención de accidentes. Al final de cada advertencia encontrará el número que le ayudará a encontrar el texto traducido en el apartado de traducciones que acompaña a este dispositivo.

GUARDE ESTAS INSTRUCCIONES

Varning! VIKTIGA SÄKERHETSANVISNINGAR

Denna varningssignal signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanliga förfaranden för att förebygga olyckor. Använd det nummer som finns i slutet av varje varning för att hitta dess översättning i de översatta säkerhetsvarningar som medföljer denna anordning.

SPARA DESSA ANVISNINGAR**Figyelem FONTOS BIZTONSÁGI ELOÍRÁSOK**

Ez a figyelmeztető jel veszélyre utal. Sérülésveszélyt rejtő helyzetben van. Mielőtt bármely berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplő figyelmeztetések fordítása a készülékhez mellékelt biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján kereshető meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!**Предупреждение ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ**

Этот символ предупреждения обозначает опасность. То есть имеет место ситуация, в которой следует опасаться телесных повреждений. Перед эксплуатацией оборудования выясните, каким опасностям может подвергаться пользователь при использовании электрических цепей, и ознакомьтесь с правилами техники безопасности для предотвращения возможных несчастных случаев. Воспользуйтесь номером заявления, приведенным в конце каждого предупреждения, чтобы найти его переведенный вариант в переводе предупреждений по безопасности, прилагаемом к данному устройству.

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告 重要的安全性说明

此警告符号代表危险。您正处于可能受到严重伤害的工作环境中。在您使用设备开始工作之前，必须充分意识到触电的危险，并熟练掌握防止事故发生的标准工作程序。请根据每项警告结尾提供的声明号码来找到此设备的安全性警告说明的翻译文本。

请保存这些安全性说明

警告 安全上の重要な注意事項

「危険」の意味です。人身事故を予防するための注意事項が記述されています。装置の取り扱い作業を行うときは、電気回路の危険性に注意し、一般的な事故防止策に留意してください。警告の各国語版は、各注意事項の番号を基に、装置に付属の「Translated Safety Warnings」を参照してください。

これらの注意事項を保管しておいてください。

Related Documentation

For instructions on installing and configuring Catalyst 6500 series switches, refer to these publications:

- *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches*
- *Site Preparation and Safety Guide*
- *Catalyst 6500 Series Switch Quick Software Configuration Guide*
- *Catalyst 6500 Series Switch Installation Guide*
- *Catalyst 6000 Series Switch Installation Guide*
- *Catalyst 6500 Series Switch Software Configuration Guide*
- *Catalyst 6500 Series Switch Command Reference*
- *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide*
- *Catalyst 6500 Series Switch Cisco IOS Command Reference*
- *ATM Software Configuration and Command Reference—Catalyst 5000 Family and Catalyst 6500 Series Switches*
- *System Message Guide—Catalyst 6500 Series, Catalyst 4500 Series, Catalyst 2948G, and Catalyst 2980G Switches*
- *Installation Note for the CWDM Passive Optical System*
- For information about MIBs, refer to the following World Wide Web site:
<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>

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Cisco TAC Website

The Cisco TAC website (<http://www.cisco.com/tac>) provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The Cisco TAC website is available 24 hours a day, 365 days a year.

Accessing all the tools on the Cisco TAC website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a login ID or password, register at this URL:

<http://tools.cisco.com/RPF/register/register.do>

Opening a TAC Case

Using the online TAC Case Open Tool (<http://www.cisco.com/tac/caseopen>) is the fastest way to open P3 and P4 cases. (P3 and P4 cases are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Case Open Tool automatically recommends resources for an immediate solution. If your issue is not resolved using the recommended resources, your case will be assigned to a Cisco TAC engineer.

For P1 or P2 cases (P1 and P2 cases are those in which your production network is down or severely degraded) or if you do not have Internet access, contact Cisco TAC by telephone. Cisco TAC engineers are assigned immediately to P1 and P2 cases to help keep your business operations running smoothly.

To open a case by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)

EMEA: +32 2 704 55 55

USA: 1 800 553-2447

For a complete listing of Cisco TAC contacts, go to this URL:

<http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml>

TAC Case Priority Definitions

To ensure that all cases are reported in a standard format, Cisco has established case priority definitions.

Priority 1 (P1)—Your network is “down” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Priority 2 (P2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Priority 3 (P3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Priority 4 (P4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- The Cisco Product Catalog describes the networking products offered by Cisco Systems, as well as ordering and customer support services. Access the Cisco Product Catalog at this URL:

http://www.cisco.com/en/US/products/products_catalog_links_launch.html

- Cisco Press publishes a wide range of general networking, training and certification titles. Both new and experienced user will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press online at this URL:

<http://www.ciscopress.com>

- Packet magazine is the Cisco quarterly publication that provides the latest networking trends, technology breakthroughs, and Cisco products and solutions to help industry professionals get the most from their networking

investment. Included are networking deployment and troubleshooting tips, configuration examples, customer case studies, tutorials and training, certification information, and links to numerous in-depth online resources. You can access Packet magazine at this URL:

<http://www.cisco.com/packet>

- iQ Magazine is the Cisco bimonthly publication that delivers the latest information about Internet business strategies for executives. You can access iQ Magazine at this URL:

<http://www.cisco.com/go/iqmagazine>

- Internet Protocol Journal is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

http://www.cisco.com/en/US/about/ac123/ac147/about_cisco_the_internet_protocol_journal.html

- Training—Cisco offers world-class networking training. Current offerings in network training are listed at this URL:

<http://www.cisco.com/en/US/learning/index.html>



Product Overview

This chapter describes the Catalyst 6000 series switches, the Catalyst 6500 series switches, supervisor engines, and switching modules. This chapter contains these sections:

- Catalyst 6000 Series Switches, page 1-2
- Catalyst 6500 Series Switches, page 1-4
- Supervisor Engines, page 1-8
- 10/100 and 10/100/1000 Ethernet Switching Modules, page 1-16
- Gigabit Ethernet Switching Modules, page 1-36
- Ethernet Module LEDs, page 1-47
- ATM Modules, page 1-48
- FlexWAN Module (WS-X6182-2PA), page 1-52
- Multilayer Switch Module (WS-X6302-MSM), page 1-54
- Network Analysis Modules, page 1-58
- Firewall Services Module (WS-SVC-FWM-1-K9), page 1-63

- IPsec VPN Acceleration Services Module (WS-SVC-IPSEC-1), page 1-66
- Intrusion Detection System Module (WS-X6381-IDS), page 1-68
- Content Switching Module (WS-X6066-SLB-APC), page 1-71
- Switch Fabric Modules, page 1-72
- Voice-Related Modules, page 1-75
- Port Addresses, page 1-84
- Hot Swapping Supervisor Engines and Switching Modules, page 1-87
- Power Management and Environmental Monitoring, page 1-88

Catalyst 6000 Series Switches

The Catalyst 6000 series switches consist of the following two chassis:

- Catalyst 6006 (6 slots)
- Catalyst 6009 (9 slots)

These high-performance, modular, frame-based switches support high-density Fast Ethernet and Gigabit Ethernet in both campus-backbone and server-aggregation environments. The Catalyst 6006 and the Catalyst 6009 switches have a 32-Gbps switching capacity. Both platforms share the same supervisor engines, switching modules, and software, and they support redundant configurations of supervisor engines, power supplies, and port interfaces.

ATM LAN Emulation (LANE) and Multiprotocol over ATM (MPOA) support is provided by the ATM dual PHY OC-12 LANE/MPOA module.



Note

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.



Note

Throughout this publication, except where noted, the term *supervisor engine* is used to refer to Supervisor Engine 1, Supervisor Engine 2, and Supervisor Engine 720.

**Note**

The uplink ports are fully functional on the redundant supervisor engine in standby mode.

The Catalyst 6000 series switches support the following hardware:

- A supervisor engine with two gigabit interface uplinks and an optional redundant supervisor engine

**Note**

Supervisor Engine 720 is not supported in the Catalyst 6006 and Catalyst 6009 switches.

Both supervisor engines in a single chassis must be completely identical. You can configure the redundant supervisor engines in a Catalyst 6000 series switch in one of three configurations:

- Two supervisor engines, each with no Multilayer Switch Feature Card (MSFC) and no Policy Feature Card (PFC)
- Two supervisor engines, each configured with a PFC daughter card
- Two supervisor engines, each configured with both an MSFC and a PFC daughter card
- Additional switching modules (Ethernet, Fast Ethernet, Gigabit Ethernet, and ATM) in any combination
 - Five additional switching modules in the Catalyst 6006
 - Eight additional switching modules in the Catalyst 6009

**Note**

The Switch Fabric Modules are not supported in the Catalyst 6000 series switches.

- Hot-swappable fan assembly and modules
- Redundant AC-input or DC-input power supplies
- Backplane bandwidth of 32 Gbps

Catalyst 6500 Series Switches

The Catalyst 6500 series switches consist of the following six chassis:

- Catalyst 6503 (3 slots)
- Catalyst 6506 (6 slots)
- Catalyst 6509 (9 slots)
- Catalyst 6509-NEB (9 slots, vertical)
- Catalyst 6509-NEB-A (9 slots, vertical)
- Catalyst 6513 (13 slots)

The Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB, Catalyst 6509-NEB-A, and Catalyst 6513 switches can support a backplane architecture that scales from 32 Gbps to 256 Gbps. The Catalyst 6503 switch backplane architecture is limited to 32 Gbps.

The Catalyst 6500 series switches support the following hardware:

- A supervisor engine with two gigabit interface uplinks and an optional redundant supervisor engine.



Note The Supervisor Engine 720 also has a 10/100/1000 Mbps uplink port.

Both supervisor engines in a single chassis must be completely identical. You can configure the redundant supervisor engines in a Catalyst 6500 series switch in one of three configurations:

- Two supervisor engines, each with no Multilayer Switch Feature Card (MSFC) and no Policy Feature Card (PFC)
- Two supervisor engines, each configured with a PFC daughter card
- Two supervisor engines, each configured with both an MSFC and a PFC daughter card



Note The Catalyst 6513 switch requires either the Supervisor Engine 2 or Supervisor Engine 720.

- Additional switching modules in any combination:

- Two additional switching modules in the Catalyst 6503 switch
- Five additional switching modules in the Catalyst 6506 switch
- Eight additional switching modules in the Catalyst 6509, Catalyst 6509-NEB, and Catalyst 6509-NEB-A switches
- Twelve additional switching modules in the Catalyst 6513 switch

**Note**

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

- Hot-swappable fan assembly and modules

**Note**

For a Supervisor Engine 720, you need to install a high-speed fan tray and install a 2500 W or larger power supply.

- Redundant AC-input or DC-input power supplies
- Scalable backplane bandwidth of 32 Gbps, up to 256 Gbps
- A Switch Fabric Module (WS-C6500-SFM or WS-X6500-SFM2)
 - Only the Supervisor Engine 2 supports the Switch Fabric Module.
 - Supervisor Engine 720 does not support the Switch Fabric Modules.
 - Either the WS-C6500-SFM or WS-X6500-SFM2 Switch Fabric Module can be installed in slot 5 of the Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB switches, and Catalyst 6509-NEB-A. A redundant Switch Fabric Module can be installed in slot 6.
 - Only the WS-X6500-SFM2 Switch Fabric Module can be installed in slot 7 of the Catalyst 6513 switch. A redundant WS-X6500-SFM2 Switch Fabric Module can be installed in slot 8.



Note

For redundancy, you can install a redundant Switch Fabric Module. The module that is installed first functions as the primary module. When you install two Switch Fabric Modules at the same time, the module in slot 5 or slot 7 acts as the primary module, and the module in slot 6 or slot 8 acts as the backup. If you reset the module in slot 5 or slot 7, the module in slot 6 or slot 8 becomes the primary module.

- A combination of an SFM (WS-C6500-SFM) with an SFM2 (WS-X6500-SFM2) in the same Catalyst 6506, Catalyst 6509, or Catalyst 6509-NEB chassis

Table 1-1 lists some key features of the Catalyst 6500 series switches.

Table 1-1 Catalyst 6500 Series Switches Key Features

Feature	Description
Performance and Configuration	Refer to the <i>Catalyst 6500 Series Switch Software Configuration Guide</i> or the <i>Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide</i> for detailed information about the features supported on the switches.
Supervisor Engine 1 and Supervisor Engine 2	• Modular, upgradable feature modules for core switching logic. • Two modular Gigabit Ethernet ports supporting GBICs¹. • MSFC² and PFC³supported. • PCMCIA slot. • Console port for terminal and modem access.
Fault Tolerance and Redundancy	• Support for two hot-swappable supervisor engines. • Fast switchover for redundant supervisor engine and switching modules. • Support for two fully redundant AC- or DC-input, load-sharing power supplies. • Power management for modules and power supplies. • Environmental monitoring of critical system components. • Hot-swappable fan assembly. High-speed fan tray also available⁴. • Redundant clock modules.

Table 1-1 Catalyst 6500 Series Switches Key Features (continued)

Feature	Description
Component Hot-Swapping	Modules (including the supervisor engine if you have redundant supervisor engines) and fans can be replaced without interrupting the system power or causing other software or interfaces to shut down.
Memory Components	• 512-KB NVRAM stores configuration information. • EEPROM⁵ component on the supervisor engine stores module-specific information, such as the module serial number, part number, controller type, hardware revision, configuration information, and other details unique to each module. • 128-MB DRAM (Supervisor Engine 1A), 128-MB DRAM (Supervisor Engine 2), 256-MB DRAM (Supervisor Engine 2U), or 512-MB DRAM (Supervisor Engine 720) for the default system software. • 16-MB (Supervisor Engine 1), 32-MB (Supervisor Engine 2), or 64-MB (Supervisor Engine 720) Flash memory stores and runs software images. • PC Flash—One or two slots for an optional Flash PC card, Compact Flash card, or MicroDrive; use this additional memory to store and run software images and configuration files, or to serve as an I/O device. • Flash file system—Flash memory contains a file system. You can use a variety of commands to manage the file system (such as cd, pwd, dir, and delete). The file system includes the following devices: – Onboard bootflash – PC Flash slot
Management	• CLI through the console port or Telnet • Simple Network Management Protocol

1. GBICs = Gigabit Interface Converters
2. MSFC = Multilayer Switch Feature Card
3. PFC = Policy Feature Card
4. The high-speed fan tray is required if you install a Supervisor Engine 720. The high-speed fan tray requires that a 2500 W or larger power supply be installed in the chassis.
5. EEPROM = electrically erasable programmable read-only memory

Supervisor Engines

This section describes the features found on Supervisor Engine 1, Supervisor Engine 2, and Supervisor Engine 720. This section contains the following topics:

- LEDs, page 1-12
- RESET Button, page 1-13
- CONSOLE Port, page 1-13
- CONSOLE PORT MODE Switch, page 1-14
- Switch Load, page 1-15
- PCMCIA Slot, page 1-15
- Uplink Ports, page 1-15



Note

The Catalyst 6513 switch requires a Supervisor Engine 2 or Supervisor Engine 720.

The supervisor engine configurations are listed in Table 1-2.

Table 1-2 Supervisor Engines

Product Number	Description
Supervisor Engine 1¹	
WS-X6K-SUP1-2GE	• Supervisor Engine 1, dual 1000BASE-X GBIC uplinks • QoS port architecture (Rx/Tx) is 1q4t/2q2t
WS-X6K-SUP1A-2GE	• Supervisor Engine 1A, dual 1000BASE-X GBIC uplinks • QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t
WS-X6K-S1A-MSFC2	• Supervisor Engine 1A, dual 1000BASE-X GBIC uplinks, PFC and MSFC2 daughter cards • QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t

Table 1-2 Supervisor Engines (continued)

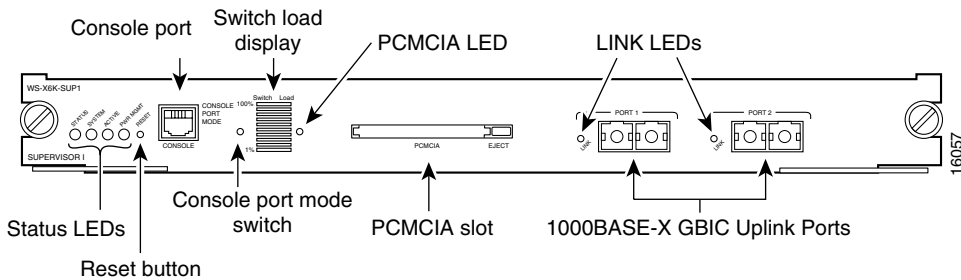
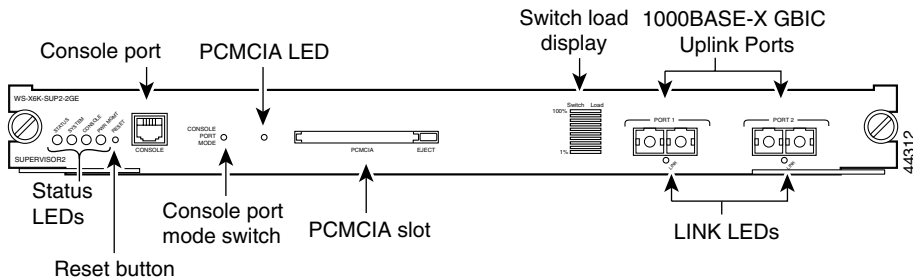
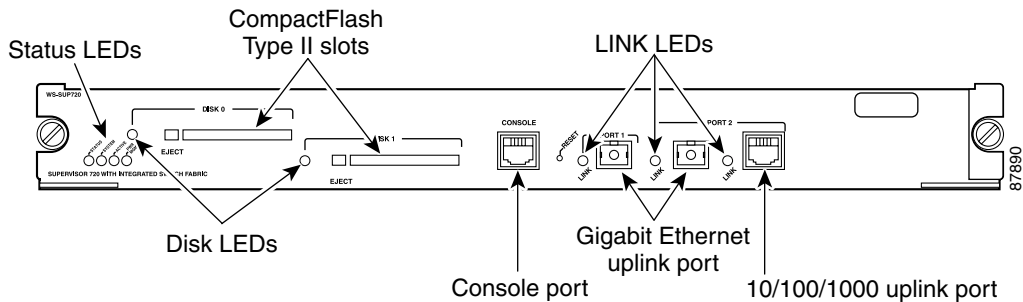
Product Number	Description
WS-X6K-SUP1A-MSFC	- Supervisor Engine 1A, dual 1000BASE-X GBIC uplinks, PFC and MSFC daughter cards - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t
WS-XSUP1A-PFC	- Supervisor Engine 1A, dual 1000BASE-X GBIC uplinks, PFC daughter card - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t
Supervisor Engine 2	
WS-X6K-S2-MSFC2	- Supervisor Engine 2, dual 1000BASE-X GBIC uplinks, fabric-enabled, supports a PFC2 and an MSFC2, 128 MB on supervisor engine, 128 MB on MSFC2 - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t
WS-X6K-S2U-MSFC2	- Supervisor Engine 2, dual 1000BASE-X GBIC uplinks, fabric-enabled, supports a PFC2 and an MSFC2, 256 MB on supervisor engine, 256 MB on MSFC2 - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t
WS-X6K-S2-PFC2	- Supervisor Engine 2, dual 1000BASE-X GBIC uplinks, fabric-enabled, and supports a PFC2 - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t

Table 1-2 Supervisor Engines (continued)

Product Number	Description
Supervisor Engine 720	
Supervisor Engine 720 ²	- Two Ethernet uplink ports: port 1 supports gigabit Small Form-Factor Pluggable (SFP) module; port 2 configurable with either a gigabit SFP or a 10/100/1000 Mbps RJ-45 - Integrated 720-Gbps Switch Fabric 2 CompactFlash Type II slots (DISK 0 and DISK 1) - Must be installed in slots 5 or 6 in a 6-slot and a 9-slot chassis, and slots 7 or 8 in a 13-slot chassis - Requires installation of a high-speed fan tray - Policy Feature Card 3A (PFC3A) - Multilayer Switch Feature Card 3 (MSFC3) with 64-MB bootflash device and 512-MB DRAM - QoS port architecture (Rx/Tx) is 1p1q4t/1p2q2t

- Supervisor Engine 1 is not supported in the Catalyst 6513 switch.
- Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Figure 1-1 shows the front panel features of Supervisor Engine 1, Figure 1-2 shows the front panel features of Supervisor Engine 2, and Figure 1-3 shows the front panel features of the Supervisor Engine 720.

Figure 1-1 Supervisor Engine 1 Front Panel Features**Figure 1-2 Supervisor Engine 2 Front Panel Features****Figure 1-3 Supervisor Engine 720 Front Panel Features**

LEDs

The LEDs on the supervisor engine front panel indicate the status of the supervisor engine, modules, power supplies, and the fan assembly. Table 1-3 lists the LEDs and their function.

Table 1-3 Supervisor Engine LEDs

LED	Color/State	Description
STATUS	Green	All diagnostics pass. The module is operational (normal initialization sequence).
	Orange	The module is booting or running diagnostics (normal initialization sequence).
	Red	An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) The diagnostic test failed. The module is not operational because a fault occurred during the initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)
SYSTEM ¹	Green	All chassis environmental monitors are reporting OK.
	Orange	The power supply has failed or the power supply fan has failed. Incompatible power supplies are installed. The redundant clock has failed. One VTT ² module has failed or the VTT module temperature minor threshold has been exceeded ³ .
	Red	Two VTT modules fail or the VTT module temperature major threshold has been exceeded ³ . The temperature of the supervisor engine major threshold has been exceeded.
ACTIVE	Green	The supervisor engine is operational and active.
	Orange	The supervisor engine is in standby mode.
PWR MGMT ¹	Green	Sufficient power is available for all modules.
	Orange	Sufficient power is not available for all modules.

Table 1-3 Supervisor Engine LEDs (continued)

LED	Color/State	Description
SWITCH LOAD		If the switch is operational, the switch load meter indicates (as an approximate percentage) the current traffic load over the backplane.
PCMCIA		The PCMCIA LED is lit when no Flash PC card is in the slot, and it goes off when you insert a Flash PC card.
LINK	Green	The port is operational.
	Orange	The link has been disabled by software.
	Flashing orange	The link is bad and has been disabled due to a hardware failure.
	Off	No signal is detected.

1. The SYSTEM and PWR MGMT LED indications on a redundant supervisor engine are synchronized to the active supervisor engine.
2. VTT = voltage termination module. The VTT module terminates signals on the Catalyst switching bus.
3. If no redundant supervisor engine is installed and there is a VTT module minor or major overtemperature condition, the system shuts down.

RESET Button

The RESET button allows you to restart the switch.

**Note**

Use a ballpoint pen tip or other small, pointed object to access the RESET button.

CONSOLE Port

The CONSOLE port allows you to access the switch either locally (with a console terminal) or remotely (with a modem). The CONSOLE port is an EIA/TIA-232 asynchronous, serial connection with hardware flow control and an RJ-45 connector.

**Note**

EIA/TIA-232 and EIA/TIA-449 were known as recommended standards RS-232 and RS-449 before their acceptance as standards by the Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA).

For detailed information on using this port, see the “Connecting to the Console Port—Supervisor Engine Only” section on page 3-15.

CONSOLE PORT MODE Switch

The CONSOLE PORT MODE switch allows you to connect a terminal to the supervisor engine using either a Catalyst 5000 family Supervisor Engine III console cable or the console cable and adapters provided with the Catalyst 6000 series or Catalyst 6500 series switch.

**Note**

The cable and adapters shipped with the switch are the same ones used on the Cisco 2500 series routers (and other Cisco products).

Additionally, you can connect a modem to the console port using the cable and adapter provided with the switch.

**Note**

Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Place the switch in the *in* position (factory default) to connect a terminal to the console port using the console cable and data terminal equipment (DTE) adapter (labeled “Terminal”) that shipped with the switch.
You can also use this mode to connect a modem to the console port using the console cable and data communications equipment (DCE) adapter (labeled “Modem”) that shipped with the switch.
- Mode 2—Place the switch in the *out* position to connect a terminal to the console port using the Catalyst 5000 family Supervisor Engine III console cable (not provided).

For more information on using the console port, see the “Connecting to the Console Port—Supervisor Engine Only” section on page 3-15.

Switch Load

The switch load meter provides you with a visual approximation of the current traffic load across the backplane.

PCMCIA Slot

The Flash PC card (PCMCIA) slot holds a Flash PC card for additional Flash memory. You can use this Flash memory to store and run software images or to serve as an I/O device.

**Note**

Throughout this publication, the term *Flash PC card* is used in place of the term *PCMCIA card*.

For detailed information on using the Flash PC card, see the “Using Flash PC Cards” section on page 3-17.

The Supervisor Engine 720 has two PCMCIA slots. The slot labeled DISK 0 supports a CompactFlash card only. CompactFlash cards are available in 64 MB, 128 MB, and 256 MB capacities. The slot labeled DISK 1 supports either a CompactFlash card or a 1-GB MicroDrive.

Uplink Ports

The supervisor engine provides two Gigabit Ethernet ports that you can configure with any combination of copper, short-wave (SX), long-wave/long-haul (LX/LH), extended-reach (ZX), and CWDM Gigabit Interface Converters (GBICs). The two 1000BASE-X Gigabit Ethernet ports operate in full-duplex mode only.

**Note**

In a redundant configuration with two supervisor engines, the uplink ports on the redundant (standby) supervisor engine are active and can be used for normal traffic like any other ports in the chassis.

For detailed information on these ports, see the “Connecting to the Uplink Ports—Supervisor Engine Only” section on page 3-16.

The Supervisor Engine 720 has two uplink ports. The port labeled PORT 1 requires that a Small Form-Factor Pluggable (SFP) module be installed into it. The port operates at 1 Gbps. The port labeled PORT 2 has two connectors: either an SFP 1-Gbps port connector or a 10/100/1000BASE-T RJ-45 connector.

10/100 and 10/100/1000 Ethernet Switching Modules

**Note**

In this chapter, the term Catalyst 6500 series modules refers to modules that can be installed in either the Catalyst 6000 series switch chassis (Catalyst 6006 and Catalyst 6009 switches) or the Catalyst 6500 series switch chassis (Catalyst 6503, Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB, and Catalyst 6513 switches) unless specifically noted.

**Note**

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes for the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

This section describes these Catalyst 6500 series 10/100 and 10/100/1000 Ethernet switching modules:

- 24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT), page 1-20
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX), page 1-21
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX), page 1-21
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V), page 1-22
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V), page 1-23

- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT), page 1-24
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45), page 1-25
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL), page 1-25
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL), page 1-26
- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM), page 1-26
- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM), page 1-27
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V), page 1-28
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45), page 1-29
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V), page 1-30
- 24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM), page 1-31
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX), page 1-31
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX), page 1-32
- 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21), page 1-33
- 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45), page 1-34
- 48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX), page 1-35

Table 1-4 lists the features of the Ethernet switching modules.

Table 1-4 Ethernet Switching Modules Features

Product Number	Backplane Connection	Forwarding	Inline Power¹	Port Buffer Size	Queues Per Port
WS-X6024-10FL-MT	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6148-GE-TX	32 Gbps Bus	Centralized	Optional ²	128 KB	2 transmit, 1 receive
WS-6148V-GE-TX	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive
WS-X6148-RJ21V	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive
WS-X6148-RJ45V	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive
WS-X6224-100FX-MT	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive
WS-X6248-RJ-45	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6248-TEL	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6248A-TEL	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6324-100FX-MM	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6324-100FX-SM	32 Gbps Bus	Centralized	No	128 KB	2 transmit, 1 receive
WS-X6348-RJ21V	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive
WS-X6348-RJ-45	32 Gbps Bus	Centralized	Optional ²	128 KB	2 transmit, 1 receive
WS-X6348-RJ45V	32 Gbps Bus	Centralized	Yes	128 KB	2 transmit, 1 receive

Table 1-4 Ethernet Switching Modules Features (continued)

Product Number	Backplane Connection	Forwarding	Inline Power ¹	Port Buffer Size	Queues Per Port
WS-X6524-100FX-MM	Switch Fabric and Bus	Centralized Supports optional DFC card	No	1 MB	4 transmit, 2 receive
WS-X6548-GE-TX	Switch Fabric and Bus	Centralized	Optional ²	1 MB	4 transmit, 2 receive
WS-6548V-GE-TX	Switch Fabric and Bus	Centralized	Yes	1 MB	4 transmit, 2 receive
WS-X6548-RJ-21	Switch Fabric and Bus	Centralized Supports optional DFC card	No	1 MB	4 transmit, 2 receive
WS-X6548-RJ-45	Switch Fabric and Bus	Centralized Supports optional DFC card	No	1 MB	4 transmit, 2 receive
WS-X6748-GE-TX	Switch Fabric	CEF720	No	1.3 MB	4 transmit, 2 receive

1. Supports IP phones.

2. Supports an optional inline power field upgrade module (WS-F6K-VPWR=)

24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT)

The 24-port 10BASE-FL switching module (WS-X6024-10FL-MT) provides 24 switched, 10-Mbps, full- or half-duplex ports. (See Figure 1-4.) The module has 24 MT-RJ connectors for connection to multimode fiber-optic (MMF) cable.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.



Note

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

Figure 1-4 24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT)

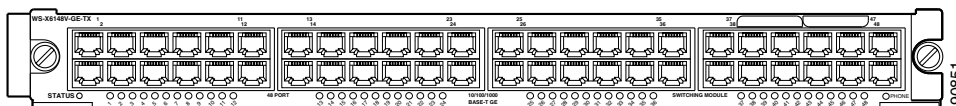


The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6148-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 1-5.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

Figure 1-5 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX)



The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX)

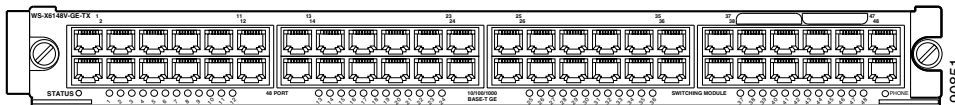
The 48-port 10/100/1000BASE-T switching module (WS-X6148V-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 1-6.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card is installed on the module. With the voice daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.

- Phone discovery—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- Auxiliary VLANs—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-6 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX)



The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V)

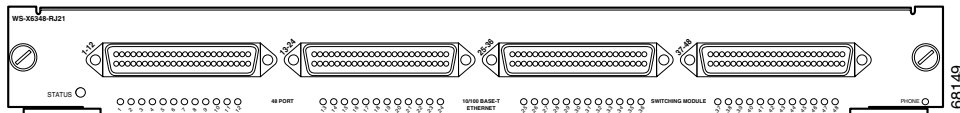
The 48-port 10/100BASE-T switching module (WS-X6148-RJ21V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 1-7.) The module has 4 RJ-21 connectors (12 ports per connector) for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- Inline power—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- Phone discovery—Automatically detects the presence of an IP phone and supplies inline power to the phone.

- Auxiliary VLANs—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-7 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V)



The front panel LEDs are described in Table 1-6 on page 1-47.

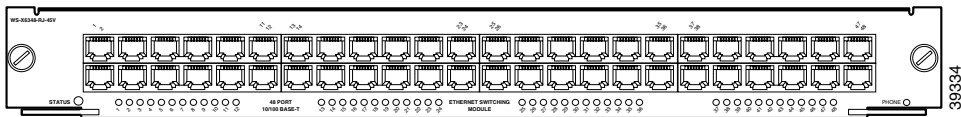
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)

The 48-port 10/100BASE-T switching module (WS-X6148-RJ45V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 1-8.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- Inline power—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- Phone discovery—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- Auxiliary VLANs—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-8 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)



The front panel LEDs are described in Table 1-6 on page 1-47.

24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)

The 24-port 100BASE-FX Ethernet switching module (WS-X6224-100FX-MT) provides 24 switched, 100-Mbps, full or half-duplex ports. (See Figure 1-9.) Ports have MT-RJ optical connectors for connection to MMF optical cable.

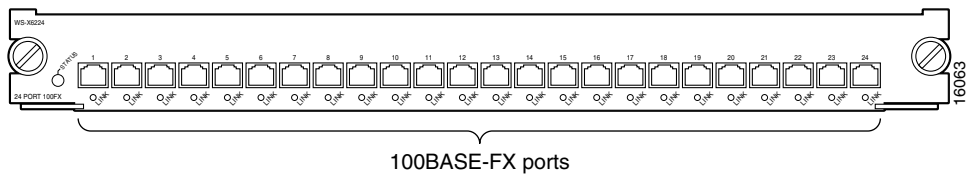


Note

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-9 24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)



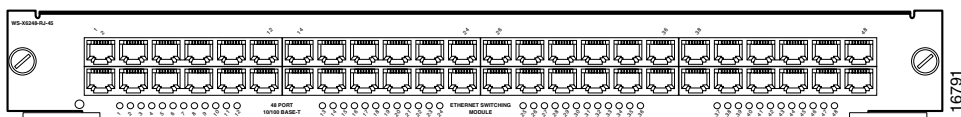
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248-RJ45) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 1-10.) The 48 ports have RJ-45 connectors for Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-10 48-Port 10/100BASE-TX Ethernet Switching Module (WS-X6248-RJ45)



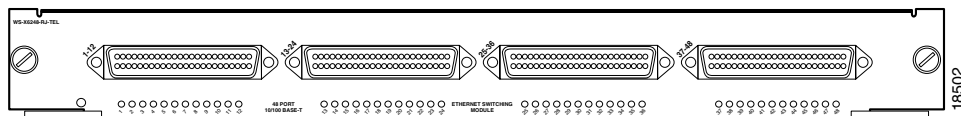
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248-TEL) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 1-11.) Four RJ-21 connectors (12 ports per connector) use Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable to connect to the network.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-11 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL)



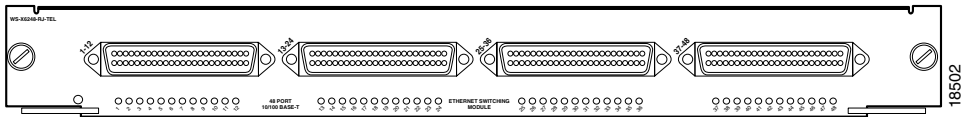
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248A-TEL) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 1-12.) The WS-X6248A-TEL Ethernet module has a larger buffer than the WS-X6248-TEL Ethernet module. Four RJ-21 connectors (12 ports per connector) use Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable to connect to the network.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-12 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)



The front panel LEDs are described in Table 1-6 on page 1-47.

24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)

The 24-port 100BASE-FX switching module (WS-X6324-100FX-MM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 1-13.) The module has 24 MT-RJ connectors for connection to the MMF cable.

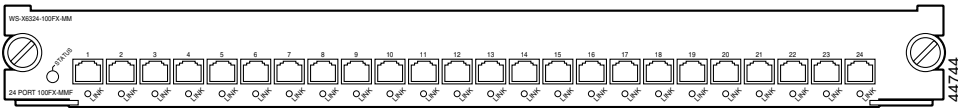


Note

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-13 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)



The front panel LEDs are described in Table 1-6 on page 1-47.

24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)

The 24-port 100BASE-FX switching module (WS-X6324-100FX-SM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 1-14.) The module has 24 MT-RJ connectors for connection to SMF cable.

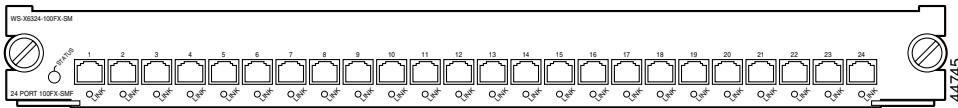


Note

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-14 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)



The front panel LEDs are described in Table 1-6 on page 1-47.

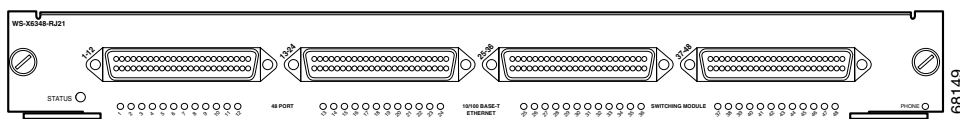
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V)

The 48-port 10/100BASE-T switching module (WS-X6148-RJ21V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 1-15.) The module has 4 RJ-21 connectors (12 ports per connector) for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-15 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-21V)



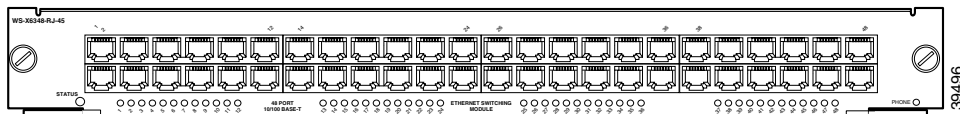
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)

The 48-port 10/100BASE-T switching module (WS-X6348-RJ-45) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 1-16.) The module has 48 RJ-45 connectors for connection to either Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-16 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)



The front panel LEDs are described in Table 1-6 on page 1-47.

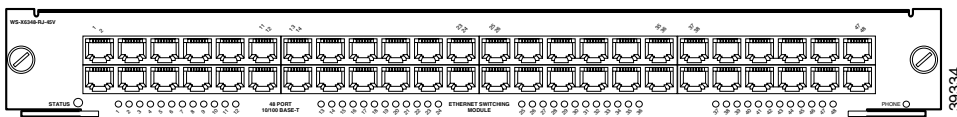
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)

The 48-port 10/100BASE-T switching module (WS-X6348-RJ45V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 1-17.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-17 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)



The front panel LEDs are described in Table 1-6 on page 1-47.

24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)

The 24-port 100BASE-FX switching module (WS-X6524-100FX-MM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 1-18.) Ports have MT-RJ connectors for MMF cable. The WS-X6524-100FX-MM module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC).



Note

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is **1p1q0t/1p3q1t**.

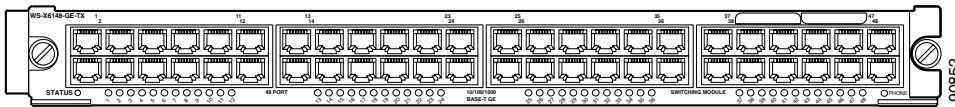
Figure 1-18 24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)



The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6548-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 1-19.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

Figure 1-19 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS_X6548-GE-TX)

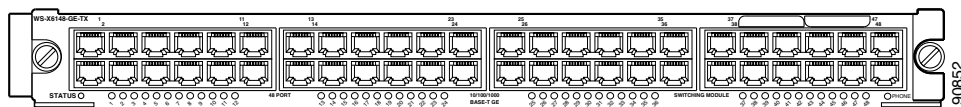
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6548V-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 1-20.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card is installed on the module. With the voice daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

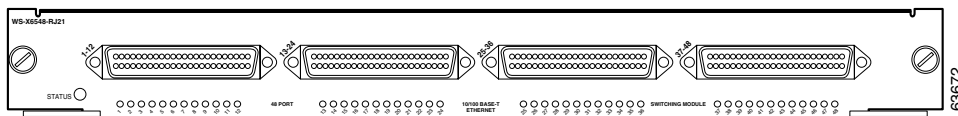
Figure 1-20 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX)

The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21)

The 48-port 10/100BASE-T switching module (WS-X6548-RJ-21) provides 48 switched, 10/100-Mbps, full- or half-duplex ports. (See Figure 1-21.) The module has 4 RJ-21 connectors (12 ports per connector) for Category 5, Category 5e, or Category 6 cable. The WS-X6548-RJ-21 module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC). The WS-X6548-RJ-21 module is auto-MDI/MDIX capable; you can use either straight or crossover cable, and the module will automatically detect and adjust for the cable type.

The QoS port architecture (Rx/Tx) for this module is **1p1q0t/1p3q1t**.

Figure 1-21 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21)

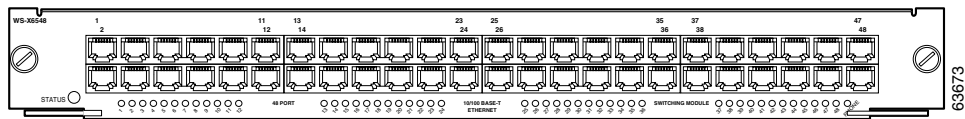
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45)

The 48-port 10/100BASE-T switching module (WS-X6548-RJ-45) provides 48 switched, 10/100-Mbps, full- or half-duplex ports. (See Figure 1-22.) Ports have RJ-45 connectors for Category 5, 5e, and 6 cable. The WS-X6548-RJ-45 module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC). The WS-X6548-RJ-45 module is auto-MDI/MDIX capable; you can use either straight or crossover cable, and the module will automatically detect and adjust for the cable type.

The QoS port architecture (Rx/Tx) for this module is **1p1q0t/1p3q1t**.

Figure 1-22 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45)



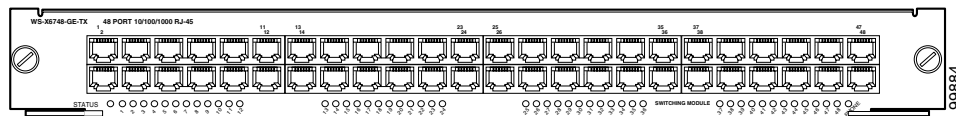
The front panel LEDs are described in Table 1-6 on page 1-47.

48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6748-GE-TX) provides 48 switched, 10/100/1000-Mbps, full- or half-duplex ports. (See Figure 1-22.) Ports have RJ-45 connectors for Category 5, Category 5e, and Category 6 cable. The WS-X6748-GE-TX module has 1.3-MB per-port packet buffers and a dual-fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC3).

The QoS port architecture (Rx/Tx) for this module is **1q8t/1p3q8t**.

Figure 1-23 48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX)



The front panel LEDs are described in Table 1-6 on page 1-47.

Gigabit Ethernet Switching Modules

This section describes these Gigabit Ethernet switching modules:

- 16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX), page 1-38
- 8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC), page 1-38
- 8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC), page 1-39
- 16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC), page 1-40
- 16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT), page 1-41
- 1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4), page 1-41
- 1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE), page 1-42
- 16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC), page 1-42
- 16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC), page 1-43
- 16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX), page 1-44
- 4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE), page 1-44
- 24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP), page 1-45
- 16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC), page 1-46

For LED indicators, see the “Ethernet Module LEDs” section on page 1-47.

Table 1-5 summarizes some of the features of the Gigabit Ethernet switching modules.

Table 1-5 Gigabit and 10-Gigabit Ethernet Switching Modules Features

Product Number	Backplane Connection	Forwarding	Number of Transmit Queues/Port	Number of Receive Queues/Port
WS-X6316-GE-TX	Bus	Centralized	3	2
WS-X6408-GBIC	Bus	Centralized	3	2
WS-X6408A-GBIC	Bus	Centralized	3	2
WS-X6416-GBIC	Bus	Centralized	3	2
WS-X6416-GE-MT	Bus	Centralized	3	2

Table 1-5 Gigabit and 10-Gigabit Ethernet Switching Modules Features (continued)

Product Number	Backplane Connection	Forwarding	Number of Transmit Queues/Port	Number of Receive Queues/Port
WS-X6501-10GEX4	Switch fabric and bus	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6502 -10GE	Switch fabric and bus	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6516-GBIC	Switch fabric and bus	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6516A-GBIC	Switch fabric and bus	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6516-GE-TX	Switch fabric and bus	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6704-10GE	Switch fabric ² (dual channel)	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6724-SFP	Switch fabric	Centralized. Support for distributed forwarding with optional DFC ¹	3	2
WS-X6816-GBIC	Switch fabric ² (dual channel)	Distributed forwarding with integrated DFC ¹	3	2

1. DFC = Distributed Forwarding Card

2. The module can be installed in slots 2–6 in the Catalyst 6506, slots 2–9 in the Catalyst 6509 and Catalyst 6509-NEB, and slots 9–13 in the Catalyst 6513 switches. It cannot be installed in slots 2–8 of the Catalyst 6513 switch. The module requires a Supervisor Engine 720.



Note

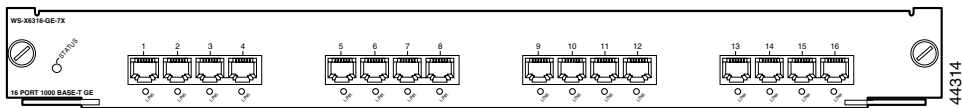
These modules are Class 1 laser products. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)

The 16-port Gigabit Ethernet switching module (WS-X6316-GE-TX) provides 16 switched, full-duplex Gigabit Ethernet ports. (See Figure 1-24.) Ports have RJ-45 connectors for Category 5 UTP. The WS-X6316-GE-TX module has enhanced QoS features.

The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

Figure 1-24 16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)



The front panel LEDs are described in Table 1-6 on page 1-47.

8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)

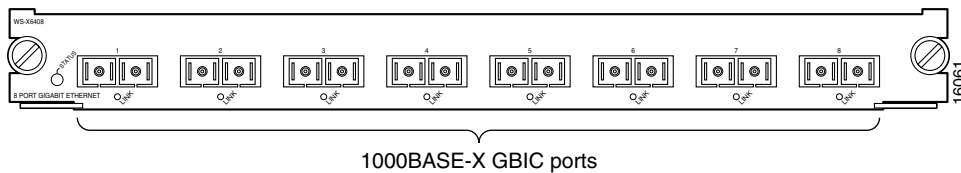
The 8-port Gigabit Ethernet switching module (WS-X6408-GBIC) provides eight switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or Coarse Wave Division Multiplexer (CWDM) GBICs. (See Figure 1-25.)



Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

Figure 1-25 8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)

The front panel LEDs are described in Table 1-6 on page 1-47.

8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)

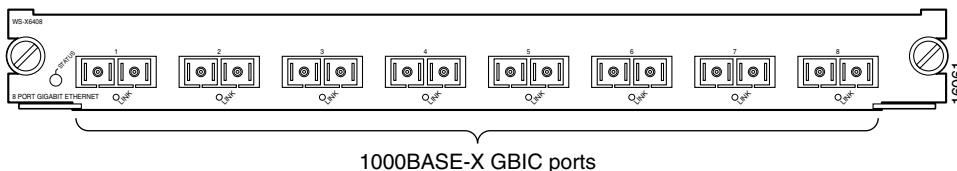
The 8-port Gigabit Ethernet switching module (WS-X6408A-GBIC) provides eight switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or Coarse Wave Division Multiplexer (CWDM) GBICs. (See Figure 1-26.) The WS-X6408A-GBIC module has enhanced QoS features.



Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

Figure 1-26 8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)

The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)

The 16-port Gigabit Ethernet switching module (WS-X6416-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 1-27.) The WS-X6416-GBIC module has enhanced QoS features.

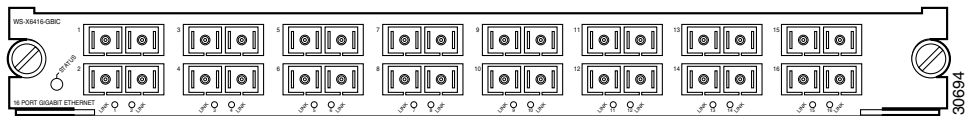


Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

Figure 1-27 16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)



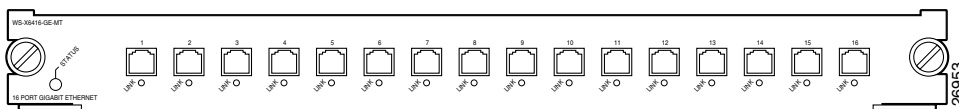
The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)

The 16-port Gigabit Ethernet switching module (WS-X6416-GE-MT) provides 16 switched, 1000-Mbps, full-duplex ports. (See Figure 1-28.) The module has 16 MT-RJ connectors for connecting to MMF cable. The WS-X6416-GE-MT module has enhanced QoS features.

The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

Figure 1-28 16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)



The front panel LEDs are described in Table 1-6 on page 1-47.

1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)

The 1-port 10-Gigabit Ethernet switching module (WS-X6501-10GEX4) provides one 10-Gigabit Ethernet port accessible through an SC connector on the front panel. (See Figure 1-29.) The WS-X6501-10GEX4 module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding with the installation of an optional Distributed Forwarding Card (WS-F6K-DFC).

Figure 1-29 1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)



The front panel LEDs are described in Table 1-6 on page 1-47.

1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE)

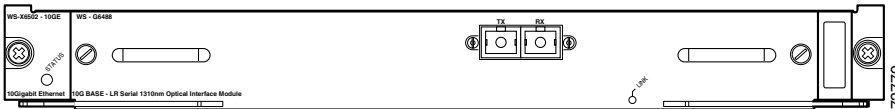
The 1-port 10-Gigabit Ethernet switching module (WS-X6502-10GE) consists of a 10-Gigabit Ethernet Base Module (WS-X6502-10GE) and an Optical Interface Module (OIM). (See Figure 1-30.) The following OIMs are currently available:

- WS-G6483 10GBASE-ER Serial 1550-nm Extended Reach OIM
- WS-G6488 10GBASE-LR Serial 1310-nm Long Haul OIM

The WS-G6483 OIM provides one serial 1550-nm 10-Gigabit Ethernet port through an SC connector. The WS-G6488 OIM provides one serial 1310-nm 10-Gigabit Ethernet port through an SC connector. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC). Refer to Table 2-8 and Table 2-9 for OIM optical specifications.

The QoS port architecture (Rx/Tx) for this module is **1p1q8t/1p2q1t**.

Figure 1-30 1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE) with the WS-G6488 OIM Installed



The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)

The 16-port Gigabit Ethernet switching module (WS-X6516-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 1-31.)



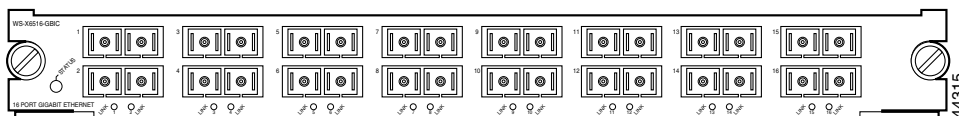
Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The WS-X6516-GBIC module has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

The WS-X6516-GBIC module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

Figure 1-31 16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)



The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)

The 16-port Gigabit Ethernet switching module (WS-X6516A-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 1-31.)

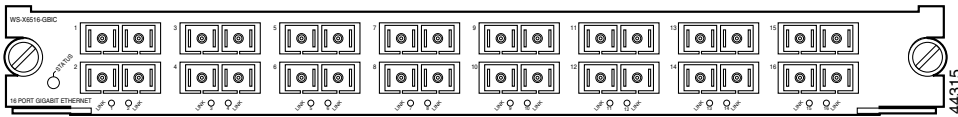


Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The WS-X6516A-GBIC module has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**. The module has 1 MB per port buffers.

The WS-X6516A-GBIC module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

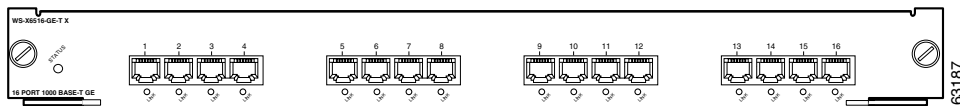
Figure 1-32 16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)

The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)

The 16-port Gigabit Ethernet switching module (WS-X6516-GE-TX) provides 16 switched, 10/100/1000BASE-T Gigabit Ethernet ports. (See Figure 1-33.) The ports have RJ-45 connectors for Category 5 UTP. The WS-X6516-GE-TX module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

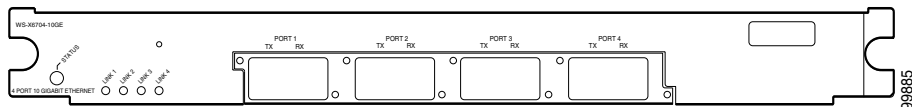
Figure 1-33 16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)

The front panel LEDs are described in Table 1-6 on page 1-47.

4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)

The 4-port 10-Gigabit Ethernet switching module (WS-X6704-10GE) provides 4 switched, 10-Gigabit Ethernet ports. (See Figure 1-34.) The four ports support hot-swappable 10GBASE-LR long-reach or 10GBASE-ER extended reach XenPak optical transceivers. The WS-X6704-10GE module has dual fabric channel interface and requires the Supervisor Engine 720.

The QoS port architecture (Rx/Tx) for this module is **1q8t/1p7q8t**.

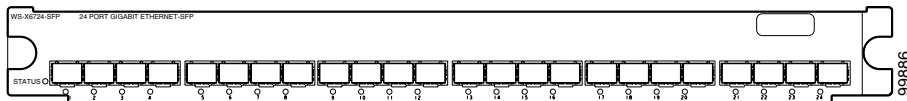
Figure 1-34 4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)

The front panel LEDs are described in Table 1-6 on page 1-47.

24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)

The 24-port Gigabit Ethernet switching module (WS-X6724-SFP) provides 24 switched, Gigabit Ethernet ports. (See Figure 1-35.) The 24 ports support hot-swappable Small Form-Factor Pluggable (SFP) 1000BASE-SX, 1000BASE-LX/LH, and 1000BASE-ZX optical transceivers. The WS-X6704-10GE module has single fabric channel interface and requires the Supervisor Engine 720.

The QoS port architecture (Rx/Tx) for this module is **1q8t/1p3q8t**.

Figure 1-35 24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)

The front panel LEDs are described in Table 1-6 on page 1-47.

16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)

The 16-Port Gigabit Ethernet switching module (WS-X6816-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 1-36.)



Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the CWDM Passive Optical System*.

The WS-X6816-GBIC is a fabric-dependent module that has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is **1p1q4t/1p2q2t**.

The WS-X6816-GBIC module has the following installation restrictions:

- The WS-X6816-GBIC requires a Supervisor Engine 2 or Supervisor Engine 720.

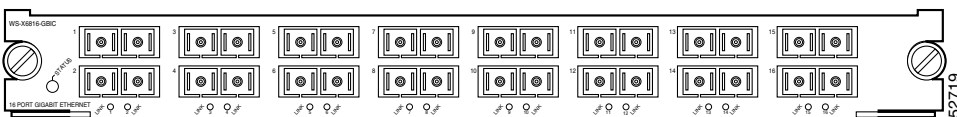


Note

The WS-X6816-GBIC must have a DFC3A daughter card installed to operate with the Supervisor Engine 720.

- A Switch Fabric Module must be installed in the Catalyst 6500 series switch chassis when a WS-X6816-GBIC module is installed.
- The WS-X6816-GBIC can be installed in slots 1 through 6 in the Catalyst 6506 switch.
- The WS-X6816-GBIC can be installed in slots 1 through 9 in the Catalyst 6509 and Catalyst 6509-NEB switches.
- The WS-X6816-GBIC can only be installed in slots 9 through 13 in the Catalyst 6513 switch; it cannot be installed in slots 1 through 8.

Figure 1-36 16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)



The front panel LEDs are described in Table 1-6 on page 1-47.

Ethernet Module LEDs

The Ethernet and Gigabit Ethernet module front-panel LEDs are described in Table 1-6.

Table 1-6 Ethernet and Gigabit Ethernet Module LEDs

LED	Color/State	Description
STATUS	Green	All diagnostics pass; the module is operational.
	Orange	The module is booting or running diagnostics.
	Red	An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
		The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence.
		An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)
	Off	If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online.
		The module is not receiving power.

Table 1-6 Ethernet and Gigabit Ethernet Module LEDs (continued)

LED	Color/State	Description
LINK	Green	The port is active (the link is connected and operational).
	Orange	The module or port is disabled through the CLI command or the module is initializing ¹ .
	Flashing orange	The port is faulty and has been disabled.
	Off	The port is not active or the link is not connected.
PHONE	Green	The voice daughter card is installed.
	Off	The voice daughter card is not detected or is not installed.

1. This is a good time to verify that all LINK LEDs are functioning.

ATM Modules

This section describes these ATM modules:

- 1-Port OC-12 ATM Module (WS-X6101-OC12-MMF), page 1-49
- 1-Port OC-12 ATM Module (WS-X6101-OC12-SMF), page 1-50
- ATM Module LEDs, page 1-51



Note

These modules are Class 1 laser products. Refer to the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* for information on working with lasers.

1-Port OC-12 ATM Module (WS-X6101-OC12-MMF)

The 1-port ATM module (WS-X6101-OC12-MMF) provides one direct connection and one standby connection between the ATM network and the switch using two multimode, SC, fiber-optic connectors. (See Figure 1-37.)

The CONSOLE PORT allows you to access the switch either locally (with a console terminal) or remotely (with a modem). The CONSOLE PORT is an EIA/TIA-232 asynchronous, serial connection with hardware flow control and an RJ-45 connector.

The CONSOLE PORT mode switch allows you to attach either a terminal or a modem to the CONSOLE PORT.



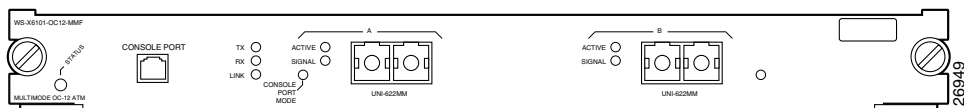
Note

Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Switch in the *in* position (factory default). Use this mode to connect a terminal to the console port using a console cable and a DTE adapter. You can also use this mode to connect a modem to the console port.
- Mode 2—Switch in the *out* position. Use this mode to connect a terminal to the console port using the Catalyst 5000 family Supervisor Engine III console cable (not provided).

Figure 1-37 ATM OC-12 Module (MMF) (WS-X6101-OC12-MMF)



The front panel LEDs are described in Table 1-7 on page 1-51.

1-Port OC-12 ATM Module (WS-X6101-OC12-SMF)

The 1-port ATM module (WS-X6101-OC12-SMF) provides one direct connection and one standby connection between the ATM network and the switch using two single-mode, SC, fiber-optic connectors. (See Figure 1-38.)

The CONSOLE PORT allows you to access the switch either locally (with a console terminal) or remotely (with a modem). The CONSOLE PORT is an EIA/TIA-232 asynchronous, serial connection with hardware flow control and an RJ-45 connector.

The CONSOLE PORT MODE switch allows you to attach either a terminal or a modem to the console port.



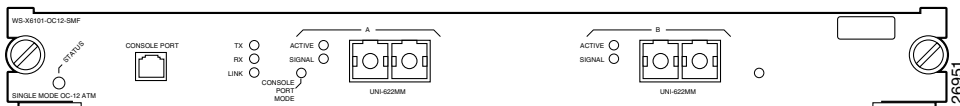
Note

Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Switch in the *in* position (factory default). Use this mode to connect a terminal to the CONSOLE PORT using a console cable and a DTE adapter. You can also use this mode to connect a modem to the console port.
- Mode 2—Switch in the *out* position. Use this mode to connect a terminal to the CONSOLE PORT using the Catalyst 5000 family Supervisor Engine III console cable (not provided).

Figure 1-38 ATM OC-12 Module (SMF) (WS-X6101-OC12-SMF)



The front panel LEDs are described in Table 1-7 on page 1-51.

ATM Module LEDs

The ATM module front-panel LEDs are described in Table 1-7.

Table 1-7 ATM Module LEDs

LED	Color/State	Description
STATUS	Green	All diagnostics pass; the module is operational.
	Orange	The module is booting or running diagnostics. A fault occurred during the initialization sequence.
	Red	An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
		The module is resetting. (The switch has just been powered on or the module has been hot inserted.) An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online.
	Off	The module is not receiving power.
TX (transmit)	Green	The port is transmitting a packet (the LED is lit for approximately 50 milliseconds).
RX (receive)	Green	The port is receiving a packet (the LED is lit for approximately 50 milliseconds).

Table 1-7 ATM Module LEDs (continued)

LED	Color/State	Description
LINK	Green	The port is active (the link is connected and operational).
	Orange	The module or port is disabled through the CLI command or the module is initializing.
	Flashing orange	The port is faulty and has been disabled.
	Off	The port is not active or the link is not connected.
ACTIVE	Green	The port is active (the link is connected and operational).
	Off	The port is the standby port.
SIGNAL	Green	The active port is receiving a valid signal level through the fiber-optic cable; this condition does not indicate valid framing.

FlexWAN Module (WS-X6182-2PA)

The FlexWAN module (WS-X6182-2PA) is installed in a switch that has a supervisor engine with an MSFC and a PFC. (See Figure 1-39.) The MSFC, in conjunction with the FlexWAN module, provides multiprotocol routing support with full Internet route connectivity for speeds ranging from serial RS-232 to OC-3. The FlexWAN module can accept up to two Cisco 7200/7500 WAN port adapters, which deliver WAN consolidation and extend QoS and traffic-management capabilities over WAN segments. The FlexWAN module supports ATM and Packet-over-SONET (POS) OC-3 links and channelized, multichannel, and clear channel port adapters. Table 1-8 lists the supported adapters.

Table 1-8 WS-X6182-2PA Supported Cisco 7200 Series and Cisco 7500 Series WAN Port Adapters

T1/E1	T3/E3 and STM-1	HSSI	ATM	Packet over SONET
PA-4T+	PA-T3	PA-H	PA-A3-T3	PA-POS-OC3MM
PA-8T-V35	PA-T3+	PA-2H	PA-A3-E3	PA-POS-OC3SMI
PA-8T-232	PA-E3		PA-A3-OC3MM	PA-POS-OC3SML
PA-8T-X21	PA-2T3		PA-A3-OC3SMI	
PA-MC-4T1	PA-2T3+		PA-A3-OC3SML	
PA-MC-8T1	PA-2E3			
PA-MC-8E1/120	PA-MC-T3			
	PA-MC-E3			
	PA-MC-STM-1			

For more information about the MSFC and PFC, refer to the *Catalyst 6500 Series Switch Software Configuration Guide*.

**Note**

Throughout this publication, except where noted, the term *MSFC* refers to both MSFC and MSFC2, and the term *PFC* refers to both PFC and PFC2.

**Note**

To use the FlexWAN module, you must have a supervisor engine with an MSFC and a PFC. You configure the FlexWAN module through the MSFC.

The STATUS LED on the FlexWAN module front panel (see Figure 1-39) indicates the status of the FlexWAN module. Table 1-9 describes the LED operation.

For information on FlexWAN module hardware and software requirements and port adapter installation and configuration, refer to the *Catalyst 6000 Family FlexWAN Module Installation and Configuration Note*.

Figure 1-39 FlexWAN Module Front Panel (WS-X6182-2PA)

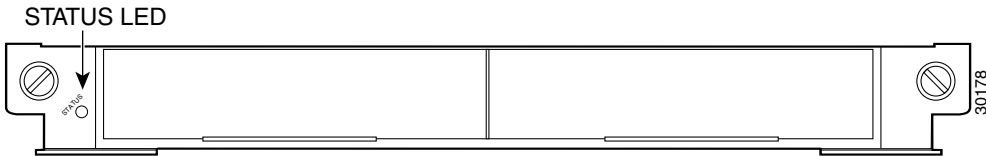


Table 1-9 FlexWAN Module STATUS LED

Color/State	Description
Green	All diagnostics pass; the module is operational.
Orange	The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
Red	A diagnostic test has failed; the module is not operational. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)

Multilayer Switch Module (WS-X6302-MSM)

The Multilayer Switch Module (MSM) (WS-X6302-MSM) provides multiprotocol routing for the switch Ethernet interfaces. Cisco IOS features available for the MSM are listed in Table 1-10.

Table 1-10 Cisco IOS Features for the Multilayer Switch Module

Feature	Description
Layer 3 forwarding	• Wire speed IP, IP multicast, and IPX routing between VLANs • Support for up to 64K entries for IP network prefixes, IP unicast and multicast addresses, IPX network numbers, and MAC addresses • IP precedence-based IP forwarding • Forwarding information base (FIB) and adjacency database support as defined in other Cisco routers • Destination or destination/source-based load sharing among equal cost paths
Layer 3 routing protocols	• Static IP routing • IP routing protocols such as Internet Group Management Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), Routing Information Protocol (RIP), and RIP-2 • IP multicast routing protocols such as Protocol Independent Multicast (PIM) (sparse and dense mode) and Distance Vector Multicast Routing Protocol (DVMRP) • IPX routing protocols such as RIP and EIGRP

Table 1-10 Cisco IOS Features for the Multilayer Switch Module (continued)

Feature	Description
Layer 3-related protocols	- IGMP v1 and v2 - IGMP snooping - Cisco Group Multicast Protocol (CGMP) server support - Full ICMP support - Gateway Discovery Protocol (GDP) - Internet Control Message Protocol (ICMP) Router Discovery Protocol (IRDP)
Enhanced services	- Integrated routing and bridging (IRB) - Standard Domain Naming System (DNS) support - Dynamic Host Configuration Protocol (DHCP) and Boot Protocol (BOOTP) relay

The MSM front panel features are shown in Figure 1-40 and are described in Table 1-11.

Figure 1-40 Multilayer Switch Module (WS-X6302-MSM)

The STATUS LED shows the results of the initialization and its dialog with the supervisor engine. Table 1-11 describes the LED operation.

For detailed information on the supervisor engine LEDs, refer to the *Catalyst 6500 Series Switch Installation Guide*.

Table 1-11 Multilayer Switch Module STATUS LED

Color/State	Description
Green	All diagnostics pass; the module is operational.
Orange	The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
Red	A diagnostic test has failed; the module is not operational. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)

The CONSOLE PORT MODE switch allows you to connect a terminal to the MSM using either a Catalyst 5000 family Supervisor Engine III console cable or the console cable and adapters provided with the switch. You also can connect a modem to the console port using the cable and adapter provided with the switch.

**Note**

Use a paper clip or a small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Place the switch in the *in* position (factory default position) to connect a terminal to the console port using the console cable and DTE adapter (labeled “Terminal”) that shipped with the switch.

You can also use this mode to connect a modem to the console port using the console cable and DCE adapter (labeled “Modem”) that shipped with the switch.

- Mode 2—Place the switch in the *out* position to connect a terminal to the console port using the Catalyst 5000 family Supervisor Engine III console cable (not provided).

Network Analysis Modules

The Network Analysis Modules (NAMs) monitor and analyze network traffic for the Catalyst 6000 series and Catalyst 6500 series switches using Remote Monitoring (RMON), RMON2, and other MIBs. The RMON support that the NAM provides for Ethernet VLANs is an extension of the RMON support provided by the supervisor engine. The switched port analyzer (SPAN) selects network traffic and directs it to the NAM. TrafficDirector, or any other IETF-compliant RMON application, can analyze link characteristics, packet layers for capacity planning or departmental accounting, differentiated service deployment and policies, and filter/capture packets for debugging.



Note

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

This section describes these Network Analysis Modules:

- Network Analysis Module (WS-SVC-NAM-1), page 1-59
- Network Analysis Module (WS-SVC-NAM-2), page 1-61

Network Analysis Module (WS-SVC-NAM-1)

The Network Analysis Module (WS-SVC-NAM-1) provides integrated network monitoring services within the switch. The NAM collects network traffic statistics for real-time traffic analysis, performance monitoring, and troubleshooting.

The NAM monitors and analyzes network traffic for the Catalyst 6500 series switches using remote monitoring (RMON), RMON extensions for switched networks (SMON), and other management information bases (MIBs). The NAM supports the following RMON groups:

- RMON groups defined in RFC 1757
- RMON2 groups defined in RFC 2021

The NAM also can monitor individual Ethernet VLANs, which allows it to serve as an extension to the basic RMON support provided by the supervisor engine.

You can use any other IETF-compliant RMON application to access link, host, protocol, and response-time statistics for capacity planning, departmental accounting, and real-time application protocol monitoring. You also can use filters and capture buffers to troubleshoot the network.

The NAM can analyze Ethernet VLAN traffic from one or both of the following sources:

- Ethernet, Fast Ethernet, Gigabit Ethernet, trunk port, or Fast EtherChannel SPAN or RSPAN source port

For more information about SPAN and RSPAN, refer to the “Configuring SPAN and RSPAN” chapter in the *Catalyst 6500 Series Software Configuration Guide*.



Note Cisco IOS software currently does not support RSPAN.

- Netflow Data Export (NDE)

For more information about NDE, refer to the *Catalyst 6500 Series Software Configuration Guide*.

The NAM-1 module has 512 MB of RAM and a 96 MB capture buffer.

The front panel LEDs are shown in Figure 1-41 and described in Table 1-12.

Figure 1-41 Network Analysis Module (WS-SVC-NAM-1)

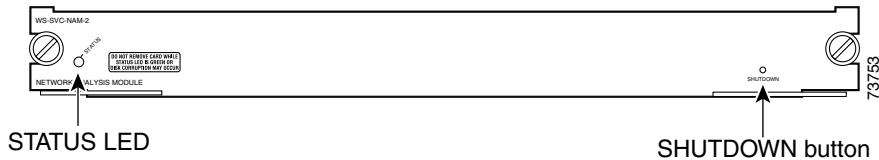


Table 1-12 NAM-1 Module STATUS LED Description

Color/State	Description
Green	All diagnostic tests pass. The NAM is operational.
Red	A diagnostic other than an individual port test failed.
Orange	Indicates one of three conditions: • The NAM is running through its boot and self-test diagnostic sequence. • The NAM is disabled. • The NAM is in the shutdown state.
Off	The NAM is powered off.

The SHUTDOWN button is used to manually shut down the NAM. To prevent corruption of the NAM, it is critical that the NAM run through the shutdown procedure before shutting off. If the NAM fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For information on NAM module hardware and software requirements and port adapter installation and configuration, refer to the *Catalyst 6500 Series Network Analysis Module Installation and Configuration Note*.

Network Analysis Module (WS-SVC-NAM-2)

The Network Analysis Module (WS-SVC-NAM-2) provides integrated network monitoring services within the switch. (See Figure 1-42.) The NAM collects network traffic statistics for real-time traffic analysis, performance monitoring, and troubleshooting.

The NAM monitors and analyzes network traffic for the Catalyst 6500 series switches using remote monitoring (RMON), RMON extensions for switched networks (SMON), and other management information bases (MIBs). The NAM supports the following RMON groups:

- RMON groups defined in RFC 1757
- RMON2 groups defined in RFC 2021

The NAM also can monitor individual Ethernet VLANs, which allows it to serve as an extension to the basic RMON support provided by the supervisor engine.

You can use any other IETF-compliant RMON application to access link, host, protocol, and response-time statistics for capacity planning, departmental accounting, and real-time application protocol monitoring. You also can use filters and capture buffers to troubleshoot the network.

The NAM can analyze Ethernet VLAN traffic from one or both of the following sources:

- Ethernet, Fast Ethernet, Gigabit Ethernet, trunk port, or Fast EtherChannel SPAN or RSPAN source port

For more information about SPAN and RSPAN, refer to the “Configuring SPAN and RSPAN” chapter in the *Catalyst 6500 Series Software Configuration Guide*.



Note Cisco IOS software currently does not support RSPAN.

- Netflow Data Export (NDE)

For more information about NDE, refer to the *Catalyst 6500 Series Software Configuration Guide*.

The NAM-2 module has 1 GB of RAM and a 128 MB capture buffer.

The front panel LEDs are shown in Figure 1-42 and described in Table 1-13.

Figure 1-42 Network Analysis Module (WS-SVC-NAM-2)

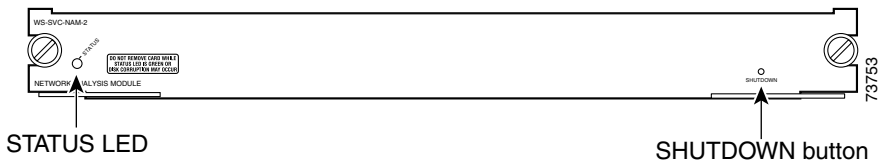


Table 1-13 NAM-2 Module STATUS LED Description

Color/State	Description
Green	All diagnostic tests pass. The NAM is operational.
Red	A diagnostic other than an individual port test failed.
Orange	Indicates one of three conditions: • The NAM is running through its boot and self-test diagnostic sequence. • The NAM is disabled. • The NAM is in the shutdown state.
Off	The NAM is powered off.

The SHUTDOWN button is used to manually shutdown the NAM. To prevent corruption of the NAM, it is critical that the NAM run through the shutdown procedure before shutting off. If the NAM fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For information on NAM module hardware and software requirements and port adapter installation and configuration, refer to the *Catalyst 6500 Series Network Analysis Module Installation and Configuration Note*.

Firewall Services Module (WS-SVC-FWM-1-K9)

The Firewall Services Module (WS-SVC-FFWM-1-K9) protects an internal (inside) network from unauthorized access by users on an external (outside) network, such as the public Internet.

**Note**

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

**Note**

The term *inside* refers to networks or network resources protected by the firewall. The term *outside* refer to networks not protected by the firewall.

The Firewall Services Module has the following features:

- Multiple modules—Supports multiple Firewall Services Modules in a Catalyst 6500 series chassis.
- Switch fabric-compatible.
- Interface configuration—Performed though native IOS CLI.
- URL filtering enhancement—The module checks the outgoing URL requests with the policy defined on a Websense Windows NT or UNIX-based server. Depending on the response from the server, which matches a request against a list of 17 website characteristics that are considered inappropriate for business use, the module either permits or denies the connection.

- **Security**—Cisco firewalls provide the latest in security technology ranging from stateful inspection firewalls to content filtering capabilities that help protect your network environment from future attacks. Another security feature is the adaptive security algorithm (ASA), which maintains the firewalled areas between the networks controlled by the firewall.

The stateful, connection-oriented ASA creates session flows based on source and destination addresses, TCP sequence numbers (which are nonpredictable), port numbers, and additional TCP flags. You can control all inbound and outbound traffic by applying security policies to each connection table entry.

- **Performance**—With support for up to 6 gigabits of throughput, firewalls can provide protection in the most demanding network environments.
- **Reliability**—Cisco firewalls provide adaptable security services for operation-critical network environments by using the integrated stateful failover capabilities within the Firewall Services Module. Network traffic can be automatically sent to a hot-standby module in the event of a failure, while maintaining concurrent connections with automated state synchronization between the primary module and the standby module.
- **Network Address Translation (NAT) and Port Address Translation (PAT)**—Cisco firewalls provide NAT and PAT services that conceal IP addresses of internal networks and expand network address space for internal networks.
- **Denial-of-service (DoS) attack prevention**—Cisco firewalls protect the firewall and networks behind them from attempts to gain access, which can bring a network to a halt.
- **Scalability**—Up to two modules are supported in a single Catalyst 6500 chassis.

The following PIX firewall features are not supported by the module:

- Virtual private networks (VPN) (the module supports IPSec VPN only for management purposes.)
- Intrusion detection system (IDS) syslog messages
- PIX Firewall Manager (PFM)
- CSPM
- Conduit
- DHCP client

The front panel LEDs are shown in Figure 1-43 and described in Table 1-14.

Figure 1-43 Firewall Services Module (WS-SVC-FWM-1-K9)

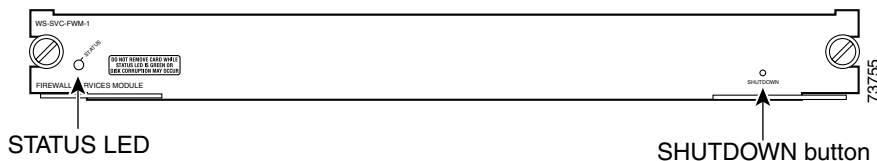


Table 1-14 Firewall Services Module STATUS LED Description

Color/State	Description
Green	All diagnostic tests pass. The module is operational.
Red	A diagnostic test other than an individual port test failed.
Orange	Indicates one of three conditions: - The module is running through its boot and self-test diagnostic sequence. - The module is disabled. - The module is in the shutdown state.
Off	The firewall module power is off.

The SHUTDOWN button is used to manually shut down the Firewall Services Module. To prevent corruption of the module, it is critical that the module run through the shutdown procedure before shutting off. If the module fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For further information on the Firewall Services Module, refer to the *Catalyst 6500 Series Firewall Services Module Installation and Configuration Note*.

IPSec VPN Acceleration Services Module (WS-SVC-IPSEC-1)

The IPSec VPN Acceleration Services module is a Gigabit Ethernet IPSec cryptographic module that you can install in the Catalyst 6500 series switches. (See Figure 1-44.) The VPN module provides bump-in-the-wire (BITW) IPSec implementation using VLANs.



Note

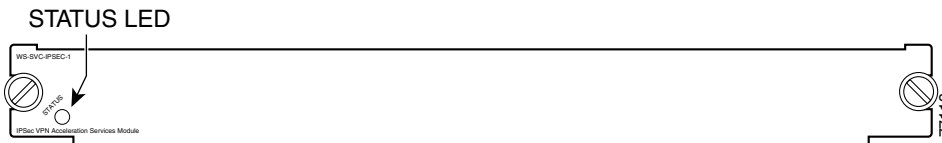
BITW is an IPSec implementation that starts egress packet processing after the IP stack has finished with the packet, and completes ingress packet processing before the IP stack receives the packet.



Note

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Figure 1-44 IPSec VPN Acceleration Services Module (WS-SVC-IPSEC-1)



Configuring VPNs using the VPN module is similar to configuring VPNs on routers running Cisco IOS software. When you configure VPNs with the VPN module, you attach crypto maps to VLANs (using interface VLANs); when you configure VPNs on routers running Cisco IOS software, you configure individual interfaces.



Note

With the VPN module, crypto maps are still attached to individual interfaces, but the set of interfaces allowed is restricted to “interface VLANs.”

When you configure a VPN on the Cisco routers, a packet is sent to a routed interface that is associated with an IP address. If the interface has an attached crypto map, the software checks that the packet is on an access control list (ACL) specified by the crypto map. If a match occurs, the packet is transformed (encrypted) before it is routed to the appropriate IPSec peer; otherwise, the packet is routed in the *clear* (unencrypted) state.

When you configure the VPN module, the same cryptographic operations are performed as on Cisco routers. The VPN module's implementation of VPN is generally the same as on Cisco routers other than the use of interface VLANs and some configuration guidelines specific to the VPN module.

**Note**

For detailed information on Cisco IOS IPSec cryptographic operations and policies, refer to the “IP Security and Encryption” section of the *Cisco IOS Security Configuration Guide*, Release 12.2.

When you configure the VPN module on the Catalyst 6500 series switch, you ensure that all packets coming from or going to the Internet pass through the VPN module. The VPN module has an extensive set of policies that validate a packet before the packet is sent onto the local (trusted) LAN. The VPN module can use multiple Fast Ethernet or Gigabit Ethernet ports on other Catalyst 6500 series modules to connect to the Internet through WAN routers. Packets received from the WAN routers pass through the VPN module for IPSec processing.

On the local LAN side, traffic between the LAN ports can be routed or bridged on multiple Fast Ethernet or Gigabit Ethernet ports. Because the local LAN traffic is not encrypted or decrypted, it does not pass through the VPN module.

The VPN module does not maintain routing information, route, or change the MAC header of a packet (except for the VLAN ID from one VLAN to another).

The front panel LED on the IPSec VPN Acceleration Services Module is described in Table 1-15.

Table 1-15 IPsec VPN Acceleration Services Module STATUS LED

Color/State	Description
Green	All diagnostic tests pass. The module is operational.
Red	A diagnostic test other than an individual port test failed.
Orange	Indicates one of three conditions: • The module is running through its boot and self-test diagnostic sequence. • The module is disabled. • The module is in the shutdown state.
Off	The module power is off.

For further information on the IPsec VPN Acceleration Services Module, refer to the *IPsec VPN Acceleration Services Module Installation and Configuration Note*.

Intrusion Detection System Module (WS-X6381-IDS)

The Intrusion Detection System Module (IDSM) is part of the Cisco Secure Intrusion Detection System (Cisco Secure IDS) and is managed by the Cisco Secure Policy Manager (Cisco Secure PM). (See Figure 1-45.) Cisco Secure PM provides a graphical interface for the management of security across a distributed network. The Intrusion Detection System Module performs network sensing, which involves real-time monitoring of network packets: packet capture and analysis.



Note

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

The Intrusion Detection System Module captures network packets, and then reassembles and compares this data against a set of rules that indicates typical intrusion activity. Network traffic is copied either to the Intrusion Detection System Module based on security VLAN access control lists (VACLs) in the switch or is routed to the Intrusion Detection System Module using the switch's Switched Port Analyzer (SPAN) port feature. Both methods allow user-specified types of traffic that are based on switch ports, VLANs, or traffic type to be inspected.

The Intrusion Detection System Module searches for patterns of misuse by examining either the data portion or the header portion of network packets. Content-based attacks come from the data portion, and context-based attacks come from the header portion.

When the Intrusion Detection System Module detects an attack, it generates an alarm. Alarms are generated by the Intrusion Detection System Module through the Catalyst 6500 series switch backplane to the Cisco Secure PM, where they are logged or displayed on a graphical user interface. Alarm communication is handled by the Cisco Secure IDS Communication service protocol, a proprietary protocol that transmits alarms from the Intrusion Detection System Module to the Cisco Secure PM.

The front panel has a STATUS LED, a hard drive LED, a SHUTDOWN button, and a PCMCIA slot as shown in Figure 1-45.

Figure 1-45 Intrusion Detection System Module (WS-X6381-IDS)

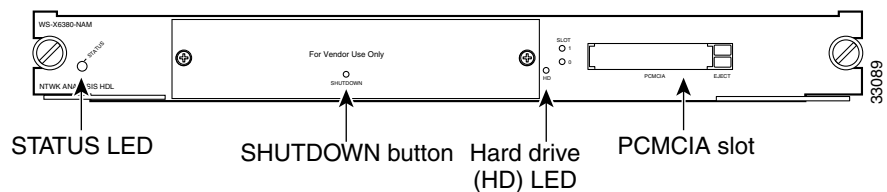


Table 1-16 describes the Intrusion Detection System Module states as indicated by the STATUS LED.

Table 1-16 Intrusion Detection System Module STATUS LED Description

Color/State	Description
Green	All diagnostics test pass. The module is operational.
Red	A diagnostic other than an individual port test failed.
Amber	The module is running through its boot and self-test diagnostics sequence.
Off	The IDSM is disabled.
	The IDSM power is off.

The SHUTDOWN button manually shuts down the Intrusion Detection System Module. To prevent corruption of the module, it is critical that you shut down the module properly. To properly shut down the switching module, session into the Intrusion Detection System Module from the Catalyst 6500 series switch console and enter the **shutdown** command. If the Intrusion Detection System Module fails to respond to the **shutdown** command, press the SHUTDOWN button to manually shut down the Intrusion Detection System Module.



Caution

Do not remove the Intrusion Detection System Module from the switch until after the module shuts down completely. Removing the module without going through a shutdown procedure can damage the module.

Use a small pointed object, such as a paper clip, to access the SHUTDOWN button and turn off the Intrusion Detection System Module. The shutdown procedure may take several minutes.

The HD (hard drive) activity LED indicates when the hard drive is in use.

The PCMCIA slot provides access for up to two standard PCMCIA cards and is reserved for future use.

Content Switching Module (WS-X6066-SLB-APC)

The Content Switching Module (WS-X6066-SLB-APC) provides high-performance sessions between network devices and a server farm (a group of network servers) based on Layer 4 through Layer 7 information packets. (See Figure 1-46.) The module allows you to represent a group of servers (real servers) as a single-server instance (virtual server), balance the traffic to the servers, and limit traffic to individual servers.

**Note**

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Figure 1-46 Content Switching Module (WS-X6066-SLB-APC)



The STATUS LED displays the Content Switching Module status as described in Table 1-17.

Table 1-17 Content Switching Module STATUS LED

Color/State	Description
Green	All diagnostic tests pass. The module is operational.
Orange	The module is running through its boot and self-test diagnostics sequence, or the module is disabled.
Red	A diagnostic test has failed.
Off	The module is powered down.

Switch Fabric Modules

This section describes these Switch Fabric Modules:

- Switch Fabric Module (WS-C6500-SFM), page 1-72
- Switch Fabric Module 2 (WS-X6500-SFM2), page 1-73



Note

You can have a Switch Fabric Module (WS-C6500-SFM) with a Switch Fabric Module 2 (WS-X6500-SFM2) in the same Catalyst 6506, Catalyst 6509, or Catalyst 6509-NEB chassis.

Switch Fabric Modules operate only with a Supervisor Engine 2. They are not supported with Supervisor Engine 1A or Supervisor Engine 720.

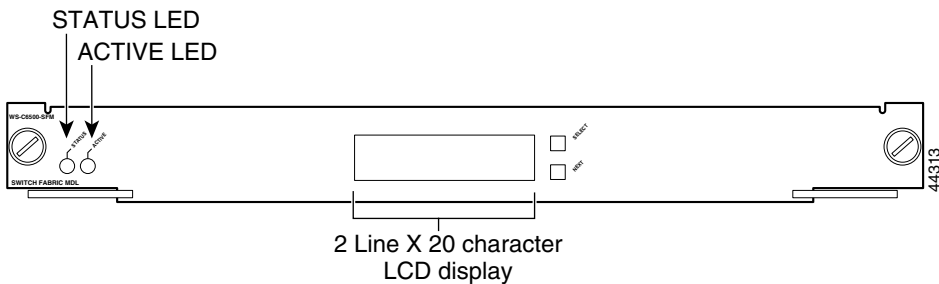
Switch Fabric Module (WS-C6500-SFM)

The Switch Fabric Module (WS-C6500-SFM) requires a Supervisor Engine 2 and must be installed in slot 5 or slot 6 of the Catalyst 6506, Catalyst 6509, or Catalyst 6509-NEB switches. (See Figure 1-47.) The Switch Fabric Module cannot be installed in the Catalyst 6513 switch or the Catalyst 6503 switch.

For redundancy, you can install a second Switch Fabric Module. The first-installed Switch Fabric Module functions as the primary module. When you install two modules at the same time, the module in slot 5 functions as the primary

module, and the module installed in slot 6 functions as the backup. If you reset the Switch Fabric Module installed in slot 5, the module in slot 6 becomes the primary.

Figure 1-47 Switch Fabric Module (WS-C6500-SFM)



Two front-panel LEDs provide status information for the module and indicate whether the module is active. The STATUS LED functions are listed in Table 1-6 on page 1-47. The ACTIVE LED is green when the Switch Fabric Module is operational and active and is orange when the module is in standby mode.

The front panel on the Switch Fabric Module has a 2-line by 20-character LCD display. The display allows you to monitor the module's input/output port traffic and local bus traffic. The display also shows system information.

Two push button switches control the LCD display:

- **SELECT**—This switch is used for LCD display menu selection.
- **NEXT**—This switch is used to scroll to the next item on the LCD display menu.

Switch Fabric Module 2 (WS-X6500-SFM2)

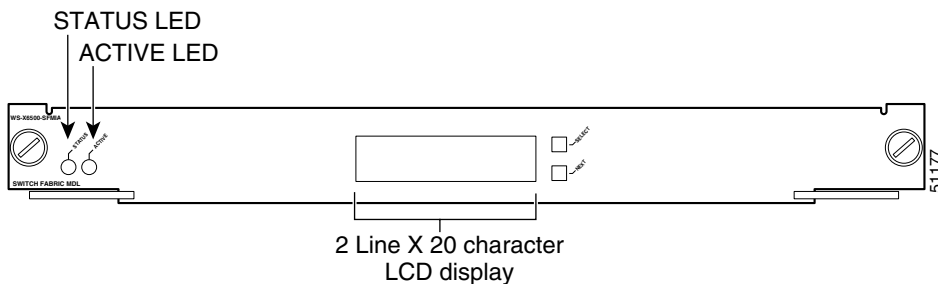
The Switch Fabric Module 2 (WS-X6500-SFM2) can be installed in any Catalyst 6500 series switch. (See Figure 1-48.) The Switch Fabric Module 2 requires Supervisor Engine 2 and must be installed in slot 5 or slot 6 of the Catalyst 6506, Catalyst 6509, or Catalyst 6509-NEB switches, or in slot 7 or slot 8 of the Catalyst 6513 switch.

**Note**

The Switch Fabric 2 module cannot be installed in the Catalyst 6503 switch.

For redundancy, you can install a second Switch Fabric Module 2. The first-installed Switch Fabric Module 2 functions as the primary module. When you install two modules at the same time, the module in slot 5 or slot 7 functions as the primary module, and the module installed in slot 6 or slot 8 functions as the standby. If you reset the Switch Fabric Module 2 installed in slot 5 or slot 7, the module in slot 6 or slot 8 becomes the primary.

Figure 1-48 Switch Fabric Module 2 (WS-X6500-SFM2)



Two front-panel LEDs provide status information for the module and indicate whether the module is active. The STATUS LED functions are listed in Table 1-6 on page 1-47. The ACTIVE LED is green when the Switch Fabric Module is operational and active and is orange when the module is in standby mode.

The front panel of the Switch Fabric Module 2 has a 2-line by 20-character LCD display. The display allows you to monitor the module's input/output port traffic and local bus traffic. The display also shows system information.

Two push button switches control the LCD display:

- **SELECT**—This switch is used for LCD display menu selection.
- **NEXT**—This switch is used to scroll to the next item on the LCD display menu.

Voice-Related Modules

This section describes these voice-related modules:

- Communications Media Module (WS-SVC-CMM), page 1-75
- 8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1), page 1-80
- 24-Port FXS Analog Interface Module (WS-X6624-FXS), page 1-82

**Note**

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Communications Media Module (WS-SVC-CMM)

The Catalyst 6500 series Communications Media Module can support single or multiple Cisco CallManagers in a voice-over-IP network. (See Figure 1-49.) The Communications Media Module, which acts as the media gateway, uses the Media Gateway Control Protocol (MGCP) to communicate with Cisco CallManager, which acts as the media gateway controller (Call Agent).

You can install up to three interface modules into the base module of the Communications Media Module. The Communications Media Module accepts either a 6-port T1 interface module or a 6-port E1 interface module. You must use the same types of interface modules (either all T1 modules or all E1 modules) in the Communications Media Module; you cannot mix the interface module types.

The 6-port T1/E1 interface modules have onboard digital signal processor (DSP) resources that allow you to connect the interfaces to the public switched telephone network (PSTN) or private branch exchanges (PBXs) through T1 Channel Associated Signaling (CAS) or T1/E1 ISDN Primary Rate Interface (PRI). The DSP resources on the interface modules provide echo cancellation, transcoding, fax relay, tone detection and generation, and jitter buffers.

The Communications Media Module provides Layer 2 forwarding only. If a packet needs to be Layer 3 routed, it is forwarded to the default gateway.

The Communications Media Module has a Gigabit Ethernet backplane interface that can have one IP address and one MAC address.



Note

The Communications Media Module requires a static IP address. Obtaining an IP address through a DHCP server is not supported. You assign an IP address to the Communications Media Module Gigabit Ethernet backplane interface through the CLI using the **interface GigabitEthernet1/0** command.



Note

For an overview of a VoIP network using the Catalyst 6500 series switches, refer to the “Configuring a VoIP Network” section of the *Catalyst 6500 Series Switch Software Configuration Guide* at this URL:

http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/sw_7_4/config_gd/voicecfg.htm

Figure 1-49 Communications Media Module (WS-SVC-CMM)

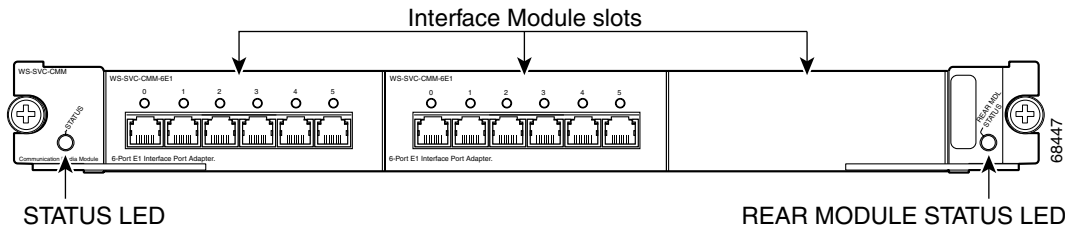


Table 1-18 lists the supported features for the Communications Media Module interface modules.

Table 1-18 CMM Interface Module Supported Features

WS-SVC-CMM-6T1 Module	WS-SVC-CMM-6E1 Module
Line code—B8ZS ¹ , AMI ²	Line code—HDB3 ³ , AMI
Frame format—SF ⁴ , ESF ⁵ with CRC ⁶ /no CRC	Frame format—with CRC4/no CRC4
MGCP: T1-PRI T1-CAS E&M ⁷ Wink Start T1-CAS E&M Delay Dial Fax Pass-through Cisco Fax Relay Modem Pass-through Music on Hold DTMF ^{8, 9} Relay G711 codec (sampling size: 10, 20, and 30 ms) G729 codec (sampling size: 10, 20, 30, 40, 50, and 60 ms)	MGCP: E1-PRI Fax Pass-through Cisco Fax Relay DTMF Relay Modem Pass-through Music on Hold G711 codec (sampling size: 10, 20, and 30 ms) G729 codec (sampling size: 10, 20, 30, 40, 50, and 60 ms)

1. B8ZS = binary 8-zero substitution
2. AMI = alternate mark inversion
3. HDB3 = high-density bipolar with three zeros
4. SF = super framing
5. ESF = extended super framing
6. CRC = cyclic redundancy check
7. E&M = ear and mouth
8. DTMF = Dual Tone Multi-Frequency
9. DTMF is supported; DTMF/MF is not supported

For additional information, refer to the *Catalyst 6500 Series and Cisco 7600 Series Communication Media Module Installation and Verification Note*.

The front panel LEDs are described in Table 1-19.

Table 1-19 CMM STATUS LED

Color/State	Description
Off	- The module is waiting for the supervisor engine to turn on power. - The module is not online. - The module is not receiving power, which could be caused by the following: - Power is not available to the module. - Module temperature is over the limit¹.
Red	- The module is released from reset by the supervisor engine and is booting. - If the boot code fails to execute, the LED stays red after power up.
Orange	- The module is initializing hardware or communicating with the supervisor engine. - A fault occurred during the initialization sequence. - If the module fails to download its Field Programmable Gate Arrays (FPGAs) on power up, it continues initializing and is granted module online status from the supervisor engine, but the LED stays orange. - If the module is not granted module online status from the supervisor engine, the LED stays orange. This problem could be caused by the supervisor engine detecting a failure in an external loopback test that it issued to the module.
Green	The module is operational; the supervisor engine has granted module online status.

1. Enter the **show environment temperature mod** command to display the temperature of each of four sensors on the module.

Figure 1-50 and Figure 1-51 show the front panels of the 6-port T1 and E1 interface modules.

Figure 1-50 6-Port T1 Interface Module

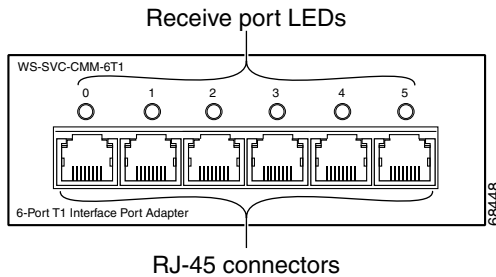
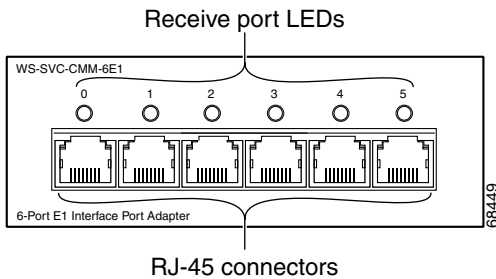


Figure 1-51 6-Port E1 Interface Module



The front panel LEDs are described in Table 1-20.

Table 1-20 6-Port T1 and E1 Interface Modules Receive Port LEDs

Color/State	Description
Green	T1/E1 interface is operational.
Red	T1/E1 receive alarm.
Yellow	T1/E1 remote alarm.
Off	The administrative port shut down or there is no power.

8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1)

The 8-port T1/E1 PSTN interface module (WS-X6608-T1/E1) is a high-density, 8-port T1/E1 voice-over-IP (VoIP) module that can support digital T1/E1 connectivity to the Public Switched Telephone Network (PSTN) or transcoding and conferencing. (See Figure 1-52.) The module requires an IP address, is registered with Cisco CallManager in its domain, and is managed by Cisco CallManager.

The module software is downloaded from a TFTP server. Depending upon which software you download, the ports can serve as T1/E1 interfaces or support transcoding and conferencing as follows:

- Transcoding for IP-to-IP connections support the following:
 - 128 channels of full-duplex transcoding per module, 16 channels per port, if transcoding is between G.711 and a low bit-rate codec (such as the G.723.1).
 - 64 channels of full-duplex transcoding per module, 8 channels per port, if transcoding is from a low bit-rate codec to a low bit-rate codec (such as from G723.1 to G.729).
 - G.711, G.723.1, and the G.729A codecs in any combination.
- Conferencing supports the following:
 - Meet-Me and ad-hoc conferencing.
 - 32 channels of conferencing ports, 4 conferencings per port. The maximum conference size on a single port is 16 parties; 6 parties at a time can be active (talking) while the rest are idle (listening).
 - Transcoding and conferencing functions; for every transcoding port in use, one less conferencing port is available and vice versa.

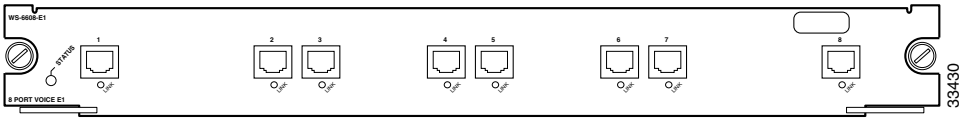
**Note**

To configure the module interfaces, refer to the “Configuring a VoIP Network” chapter of the *Catalyst 6500 Series Switch Software Configuration Guide*. To configure the interfaces to work with Cisco CallManager, refer to the *Cisco CallManager Administration Guide*.

When the 8-port T1/E1 PSTN interface module powers up, it initializes various hardware components and communicates with the supervisor engine.

The front panel LEDs are shown in Figure 1-52.

Figure 1-52 8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1)



The front panel LED operation is described in Table 1-21.

Table 1-21 8-Port PSTN Interface Module LEDs

LED	Color/State	Description
STATUS	Green	The module is operational. The supervisor engine has granted the module online status.
	Orange	The module is booting or running diagnostics.
		The supervisor engine has disabled the module.
	Red	An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
		The module is resetting. (The switch has just been powered on or the module has been hot inserted.)
	Off	The module processor detected a fatal error during its diagnostics.
		An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)
		The module is not receiving power. The module was powered down due to lack of power. (The module is listed as <i>power-deny</i> in the show module status field.)

Table 1-21 8-Port PSTN Interface Module LEDs (continued)

LED	Color/State	Description
LINK	Green	The link is up.
	Yellow	Frame synchronization has been lost or an RAI signal has been received.
	Flashing Yellow	The SPAN is in loopback.
	Red	No carrier is detected or an AIS signal has been received.
	Off	The registration with Cisco CallManager is lost.

24-Port FXS Analog Interface Module (WS-X6624-FXS)

The 24-port FXS analog interface module (WS-X6624-FXS) interfaces connect directly to standard analog telephones or fax machines. The module interfaces supply ring voltage and dial tone. The module emulates the central office (CO) or private branch exchange (PBX), providing a service to an analog telephone or fax machine. The telephone or fax machine connected through the FXS module operates as if it were connected to a normal CO or PBX line.

The front panel LEDs are shown in Figure 1-53.



Warning

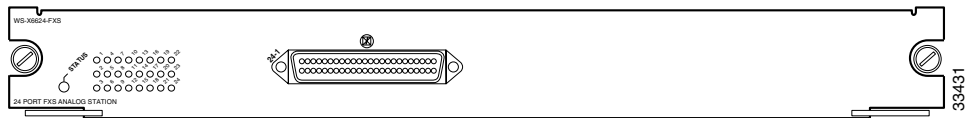
If the symbol of suitability with an overlaid cross appears above a port, you must not connect the port to a public network that follows the European Union standards. Connecting the port to this type of public network can cause severe personal injury or can damage the unit. Statement 1031



Note

When installing the WS-X6624-FXS analog interface module in a chassis, you must have a system ground cable attached to the chassis. Refer to the *Catalyst 6000 Series Switch Installation Guide* or the *Catalyst 6500 Series Switch Installation Guide* for the system grounding cable installation procedure.

Figure 1-53 24-Port FXS Analog Interface Module (WS-X6624-FXS)



When the 24-port FXS analog interface module is powered up, it initializes various hardware components and communicates with the supervisor engine. The front panel LEDs are described in Table 1-22.

Table 1-22 24-Port FXS Analog Interface Module LEDs

LED	Color/State	Description
STATUS	Green	The module is online and operational.
	Orange	The module is booting or running diagnostics.
		The supervisor engine has disabled the module.
		The supervisor engine has sent an “SCP_SET_DIAG_FEATURES” message indicating that the diagnostics have failed.
		An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)
	Red	The module processor powered up but is not running.
		The module processor detected a fatal error during its diagnostics.
		An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)
	Off	The module is not receiving power. The module was powered down due to insufficient power. (The module is listed as <i>power-deny</i> in the show module status field.)

Table 1-22 24-Port FXS Analog Interface Module LEDs (continued)

LED	Color/State	Description
Port number	Green	The telephone or fax machine is off-hook.
	Yellow	The module or port is disabled through the CLI ¹ .
	Off	The port is not active (connected device is on-hook) or the link is not connected.

1. CLI = command-line interface

Port Addresses

Each port (or interface) in the switch is designated by several different types of addresses. The physical interface address is the actual physical location (slot and port) of the interface connector within the chassis. The system software uses the physical addresses to control activity within the switch and to display status information. These physical slot and port addresses are not used by other devices in the network; they are specific to the individual switch and its internal components and software. For more information, see the “Physical Interface Addresses” section on page 1-85.



Note

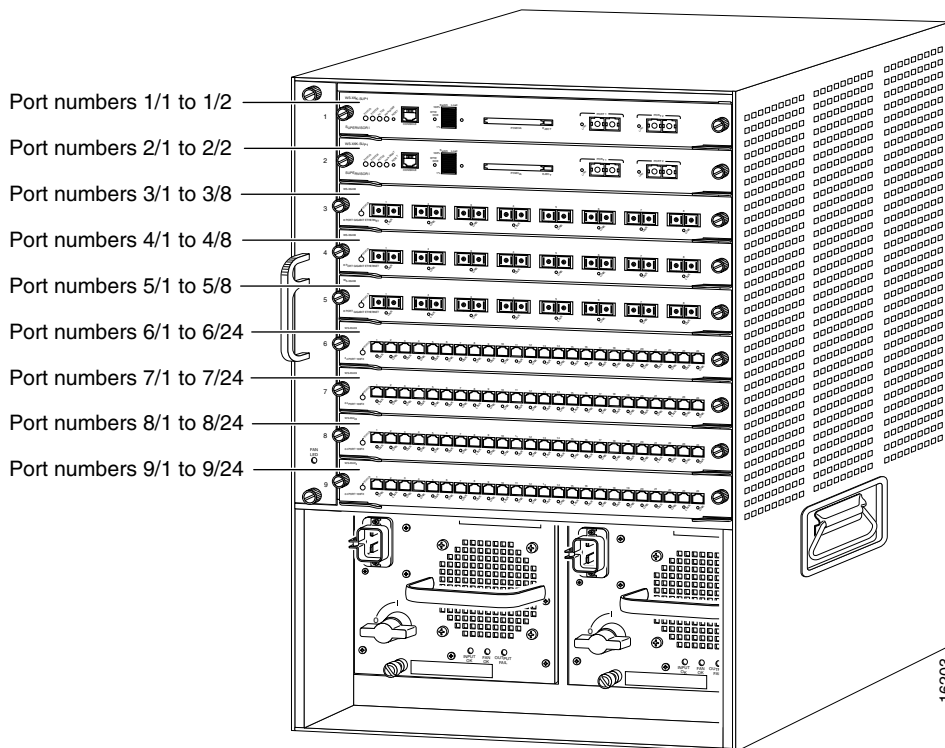
For Catalyst 6500 series switches running Cisco IOS software, refer to the *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide* for port address information.

The Media Access Control (MAC) address is a standardized data link layer address that is required for every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures. The switches use a unique method, described in the “MAC Addresses” section on page 1-86, to assign and control the MAC addresses of their interfaces.

Physical Interface Addresses

Physical port addresses specify the actual physical location of each module port on the rear of the switch, as shown in Figure 1-54. (The port numbering convention is the same in the 6-slot, 9-slot, and 13-slot chassis.) The address is a two-part number in the format *slot/port number*. The first number identifies the slot in which the module is installed. Module slots are numbered from top to bottom starting with 1. The second number identifies the physical port number on the module. The port numbers always begin at 1 and are numbered from left to right. The number of additional ports (*n/1*, *n/2*, and so on) depends on the number of ports on the module.

Figure 1-54 Catalyst 6009 and Catalyst 6509 Switch Port Address Examples



Interface ports maintain the same addresses regardless of whether other modules are installed or removed. However, when you move a module to a different slot, the first number in the address changes to reflect the new slot number. For example, on a 48-port 10/100BASE-T switching module in slot 2, the address of the left port is 2/1 and the address of the right port is 2/48. If you remove the 48-port 10/100BASE-T switching module from slot 2 and install it in slot 4, the addresses of those same ports become 4/1 through 4/48.

The supervisor engine is $n/1$ to $n/2$ because it supports two interfaces: ports 1 and 2. Switching modules are addressed $n/1$ through n/N .

You can identify each module port by checking its slot and port location on the switch. You can also use software commands to display information about a specific interface, or all interfaces, in the switch. To display information about every interface, enter the **show port** command without parameters. To display information about a specific interface, enter the **show port** command with the module (slot) number and port number in the format **show port** *[mod_num/port_num]*.

MAC Addresses

All network interface connections (ports) require a unique MAC address. The MAC address of an interface is stored in electrically erasable programmable read-only memory (EEPROM) on a component that resides directly on the interface circuitry. The switch system code reads the EEPROM for each interface in the system, learns the MAC addresses, and then initializes appropriate hardware and data structures. Each VLAN in the spanning tree has one unique MAC address. This addressing scheme gives the switch the intelligence to identify the state (*connected* or *not connected*) of each interface. When you hot swap a module, the MAC address changes with the module.

Hot Swapping Supervisor Engines and Switching Modules

You can remove and replace redundant supervisor engines and switching modules without powering down the switch. This feature is known as *hot swapping*.

When you remove or insert a switching module while the switch is powered on and operating, the switch does the following:

1. Determines if there is sufficient power for the module.
2. Scans the backplane for configuration changes.
3. Initializes all newly inserted switching modules, notes any removed modules, and places them in the administratively shutdown state.
4. Places any previously configured interfaces on the switching module back to the state they were in when they were removed. Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If you insert a similar switching-module type into a slot, its ports are configured and brought online up to the port count of the original switching module.

The switch runs diagnostic tests on any new interfaces. If the test passes, the switch is operating normally. If the new switching module is faulty, the switch resumes normal operation but leaves the new interface disabled.

If the diagnostic test fails, the switch crashes, which usually indicates that the new switching module has a problem in the bus and should be removed.

When you install two supervisor engines, hot swapping allows you to remove and replace one of the supervisor engines without turning off the system power.

**Caution**

To avoid erroneous failure messages, note the current configuration of all interfaces before you remove or replace another switching module, and allow at least 15 seconds for the system to reinitialize after a module has been removed or replaced.

Power Management and Environmental Monitoring

For detailed information on power management and environmental monitoring, refer to the *Catalyst 6500 Series Switch Software Configuration Guide* or *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide*.



Preparing for Installation

This chapter describes how to prepare your site before you install modules in the switches, and it contains these sections:

- Determining Cable Distances, page 2-2
- Port Densities, page 2-16
- Gigabit Interface Converters, page 2-18
- Software Requirements, page 2-26

This chapter does not contain instructions for installing the switch chassis. For information on installing the switch chassis, refer to the *Catalyst 6000 Series Switch Installation Guide* or the *Catalyst 6500 Series Switch Installation Guide*.

Limiting Connection Distances

The length of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, fiber-optic cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in this chapter are the IEEE-recommended maximum speeds and distances for signaling. However, if you understand the electrical problems that may arise and can compensate for them, you should get good results with rates and distances greater than those described here, although you do so at your own risk.

Determining Cable Distances

When preparing your site for network connections to the modules, you need to consider two factors for each type of interface:

- Type of cabling required for each interface
- Distance limitations for each interface

**Note**

See Appendix B, “Cable and Connector Specifications,” for connector pinouts for the modules.

This section contains the following topics:

- ATM, page 2-3
- Ethernet and Fast Ethernet, page 2-4
- Gigabit Ethernet, page 2-5
- 10-Gigabit Ethernet, page 2-7
- Patch Cord, page 2-9
- Differential Mode Delay, page 2-11
- Console Port Cabling Specifications—Supervisor Engine Only, page 2-13
- Port Connector Requirements—Switching Modules Only, page 2-14

ATM

The maximum distances for asynchronous transfer mode (ATM) fiber-optic network connections are determined by the transmitter output power, receiver sensitivity, and type of optical source. Table 2-1 lists the maximum transmission distances for multimode fiber (MMF). Table 2-2 lists the optical specifications for single-mode fiber (SMF) cables.

Table 2-1 *ATM OC-12 Optical Specifications for MMF Cables*

Characteristic	Specification
Optical source	LED
Wavelength	1300 nm
Transmitter output power	–19 to –14 dBm
Receiver sensitivity	–26 to –14 dBm
Maximum cabling distance	1640 ft (500 m)

Table 2-2 *ATM OC-12 Optical Specifications for SMF Cables*

Characteristic	Specification
Optical source	Laser
Wavelength	1300 nm
Transmitter output power	–15 to –8 dBm
Receiver sensitivity	–28 to –8 dBm
Maximum cabling distance	9.3 mi (15 km)

Ethernet and Fast Ethernet

Table 2-3 lists the IEEE maximum transmission distances for Ethernet and Fast Ethernet.

Table 2-3 Ethernet and Fast Ethernet Maximum Transmission Distances

Transceiver Speed	Cable Type	Duplex Mode	Maximum Distance Between Stations
10 Mbps	Category 3 UTP	Full and half	328 ft (100 m)
10 Mbps	Multimode fiber	Full and half	1.2 mi (2 km)
100 Mbps	Category 5 UTP	Full and half	328 ft (100 m)
100 Mbps	Single-mode fiber	Full	6.2 mi (10 km)
100 Mbps	Multimode fiber Single-mode fiber	Half	1312 ft (400 m)

Table 2-4 lists the optical characteristics for 10BASE-FL. Table 2-5 lists the optical characteristics for 100BASE-FX.

Table 2-4 10BASE-FL Optical Characteristics

Characteristic	Specification
Optical source	LED
Wavelength	850 nm
Transmitter output power	–20 to –12 dBm
Receiver sensitivity	–32.5 to –12 dBm

Table 2-5 100BASE-FX Optical Characteristics

Characteristic	Specification (Multimode)	Specification (Single Mode)
Optical source	LED	Laser
Wavelength	1300 nm	1300 nm
Transmitter output power	–20 to –14 dBm (62.5/125 micron MMF) –23.5 to –14 dBm (50/125 micron MMF)	–20 to –14 dBm (8.3/9/10 micron SMF)
Receiver sensitivity	–31 to –14 dBm	–31 to –8 dBm

Gigabit Ethernet

Table 2-6 provides the maximum transmission distance specifications for the 1000BASE-T and the 1000BASE-X interfaces, including the Gigabit Ethernet switching modules and the supervisor engine Gigabit Ethernet uplink ports. Table 2-7 lists the Gigabit Interface Converter (GBIC) channel insertion losses. All optical GBIC interfaces have SC connectors, and the minimum cable distance for the optical GBICs listed (MMF and SMF) is 6.5 feet (2 meters).

Table 2-6 Gigabit Ethernet Maximum Transmission Distances

GBIC Type	Wavelength (nm)	Copper/Fiber Type	Core Size ¹ (micron)	Modal Bandwidth (MHz km)	Cable Distance ²
WS-G5483 Copper	—	Category 5, 5e, 6 UTP	—	—	328 ft (100 m)
WS-G5484 Optical SX ³	850	MMF	62.5	160	722 ft (220 m)
			62.5	200	902 ft (275 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
WS-G5486 Optical LX/LH	1310	MMF ⁴	62.5	500	1804 ft (550 m)
			50.0	400	1804 ft (550 m)
			50.0	500	1804 ft (550 m)
		SMF	8.3/9/10	—	6.2 mi (10 km)
WS-G5487 Optical ZX	1550	SMF	8.3/9/10	—	43.5 mi (70 km) ⁶
		SMF ⁵	8.3/9/10	—	62.1 mi (100 km)

1. The numbers given for multimode fiber-optic cable refer to the core diameter. For single-mode fiber-optic cable, 8.3 microns refers to the core diameter. The 9-micron and 10-micron values refer to the mode-field diameter (MFD), which is the diameter of the light-carrying portion of the fiber. This area consists of the fiber core plus a small portion of the surrounding cladding. The MFD is a function of the core diameter, the wavelength of the laser, and the refractive index difference between the core and the cladding.
2. Distances are based on fiber loss.
3. Use with MMF only.
4. When using an LX/LH GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord (CAB-GELX-625 or equivalent) between the GBIC and the MMF cable on both the transmit and receive ends of the link. The mode-conditioning patch cord is required for link distances less than 328 feet (100 m) or greater than 984 feet (300 m). The mode-conditioning patch cord prevents overdriving the receiver for short lengths of MMF and reduces differential mode delay for long lengths of MMF.
5. Dispersion-shifted single-mode fiber-optic cable.
6. The minimum link distance for ZX GBICs is 6.2 miles (10 km) with an 8-dB attenuator installed at each end of the link. Without attenuators, the minimum link distance is 24.9 miles (40 km).

Table 2-7 GBIC Channel Insertion Loss

GBIC Device	Transmitter output power (min/max dBm)	Receiver maximum input power (dBm)	Receiver minimum sensitivity (dBm)
1000BASE-SX	-9.5/-4	0	-17
1000BASE-LX/LH	-9.5/-3	-3	-19
1000BASE-ZX	0/5	-3	-23 ¹

1. The 1000BASE-ZX GBIC provides a minimum optical power budget of 23dB. To determine the supported link distance, you should measure your cable plant with an optical loss test set to verify that the optical loss of the cable plant (including connectors and splices) is less than or equal to this value. The optical loss measurement must be performed using a 1550 nm light source.

10-Gigabit Ethernet

Table 2-8 lists the fiber-optic transmission specifications for the 10-Gigabit Ethernet interfaces. Table 2-9 lists the optical power specifications for the 10-Gigabit Ethernet interfaces.

**Caution**

To prevent severe damage to the WS-G6483 Optical Interface Module receiver, you must install a 5-dB 1550 nm fixed-loss attenuator when fiber-optic cable lengths are less than 12.4 miles (20 km). To prevent severe damage to the WS-X6501-10GEX4 receiver, you must install a 5-dB 1550 nm fixed-loss attenuator when fiber-optic cable lengths are less than 6.2 miles (10 km).

Table 2-8 10-Gigabit Ethernet Fiber-Optic Transmission Specifications

Model	Wavelength (nm)	Fiber Type	Core Size¹ (Microns)	Modal Bandwidth (MHz/km)	Cable Distance²
WS-X6501-10GEX4	1550	SMF	8.3/9/10	—	6.2–31 mi (10–50 km)
		Dispersion-shifted SMF	8.3/9/10 ³	—	6.2–31 mi (10–50 km)
WS-G6488 OIM ⁴	1310	SMF	8.3/9/10	—	6.56 ft–6.2 mi ⁵ (2 m–10 km)
		Dispersion-shifted SMF	8.3/9/10 ³	—	6.56 ft–6.2 mi ⁵ (2 m–10 km)
WS-G6483 OIM ⁶	1550	SMF	8.3/9/10	—	6.56 ft–24.8 mi ⁷ (2 m–40 km)
		Dispersion-shifted SMF	8.3/9/10	—	6.56 ft–24.8 mi ⁷ (2 m–40 km)

1. For single-mode fiber-optic cable, 8.3 microns refers to the core diameter. The 9-micron and 10-micron values refer to the mode-field diameter (MFD), which is the diameter of the light-carrying portion of the fiber. This area consists of the fiber core plus a small portion of the surrounding cladding. The MFD is a function of the core diameter, the wavelength of the laser, and the refractive index difference between the core and the cladding.
2. Refer to the 10-Gigabit Ethernet optical power specifications table to calculate the exact distances that the module supports before you install the module. The exact distances supported by this module vary depending on the number of splices and connectors in the fiber-optic cable.
3. Although dispersion-shifted fiber-optic cable helps to reduce the dispersion of the signal, attenuation of the signal still limits signal distance to 31 miles (50 km).
4. Optical Interface Module (OIM). The WS-G6488 OIM is installed in the WS-X6502-10GE 10-Gigabit Ethernet Base Module.
5. According to the IEEE 802.ae standard.
6. Optical Interface Module (OIM). The WS-G6483 OIM is installed in the WS-X6502-10GE 10-Gigabit Ethernet Base Module.
7. According to the IEEE 802.ae standard. Requires a 5 dB 1550 nm fixed-loss attenuator for distances less than 20 km. The exact distances supported by this module vary according to the number of splices and connectors in the fiber-optic cable attached to the OIM.

Table 2-9 10-Gigabit Ethernet Optical Power Specifications

Model	Average Transmitter Output Power	Average Receiver Input Power	Link Power Budget
WS-X6501-10GEX4	−3.5 dBm (minimum) +2 dBm (maximum)	−16 dBm (minimum) 0 dBm (maximum)	12.5 dB
WS-G6488 OIM ¹	−8.2 dBm (minimum) +0.5 dBm (maximum)	−14.4 dBm (minimum) +0.5 dBm (maximum)	6.2 dB
WS-G6483 OIM ¹	−4.7 dBm (minimum) +4 dBm (maximum)	−15.8 dBm (minimum) −1 dBm (maximum)	11.1 dB

1. Optical Interface Module (OIM). The WS-G6488 OIM and WS-G6483 OIM is installed in the WS-X6502-10GE 10-Gigabit Ethernet Base Module.

Patch Cord

When using the long wavelength/long haul (LX/LH) GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord (Cisco product number CAB-GELX-625 or equivalent) between the GBIC and the MMF cable on both the transmit and receive ends of the link. The patch cord is required for link distances greater than 984 feet (300 meters).

**Note**

We do not recommend using the LX/LH GBIC and MMF without a patch cord for very short link distances (10 to 100 meters). The result could be an elevated bit error rate (BER).

**Note**

The patch cord is required to comply with IEEE standards. IEEE found that link distances could not be met with certain types of fiber-optic cable due to a problem in the center of some fiber-optic cable cores. The solution is to launch light from the laser at a precise offset from the center by using the patch cord. At the output of the patch cord, the LX/LH GBIC complies with the IEEE 802.3z standard for 1000BASE-LX. For a detailed description of this problem, see the “Differential Mode Delay” section on page 2-11.

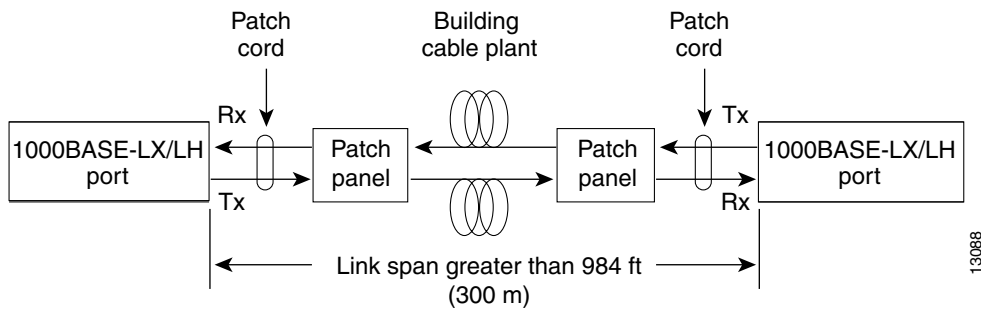
**Note**

Cisco Gigabit Ethernet products have been tested and evaluated to comply with the standards listed in Appendix A, “Technical Specifications.” Equivalent cables should also meet these standards.

Patch Cord Configuration Example

Figure 2-1 shows a typical configuration using the patch cord.

Figure 2-1 Patch Cord Configuration

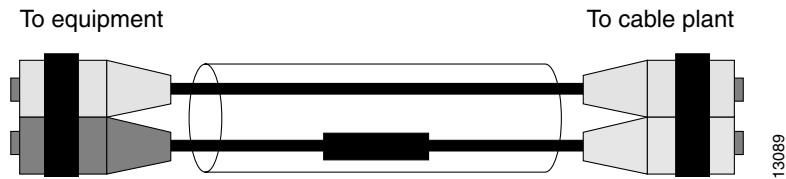


Patch Cord Installation

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

Plug the end of the patch cord labeled “To Equipment” into the GBIC. (See Figure 2-2.) Plug the end labeled “To Cable Plant” into the patch panel. The patch cord is 9.84 feet (3 meters) long and has duplex SC male connectors at each end.

Figure 2-2 Patch Cord Installation

Differential Mode Delay

When an unconditioned laser source designed for operation on a single-mode fiber (SMF) cable is directly coupled to a multimode fiber (MMF) cable, differential mode delay (DMD) might occur. DMD can degrade the modal bandwidth of the fiber-optic cable causing a decrease in the link span (the distance between the transmitter and the receiver) that can be reliably supported.

The Gigabit Ethernet specification (IEEE 802.3z) outlines parameters for Ethernet communications at a gigabit-per-second rate. The specification offers a higher-speed version of Ethernet for backbone and server connectivity using existing deployed MMF cable by defining the use of laser-based optical components to propagate data over MMF cable.

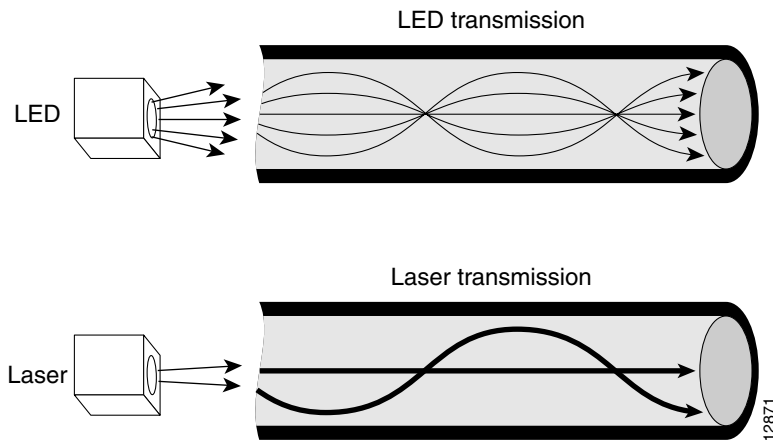
Lasers function at the baud rates and longer distances required for Gigabit Ethernet. 802.3z identifies the DMD condition that occurs with particular combinations of lasers and MMF cable. The results create an additional element of jitter that can limit the reach of Gigabit Ethernet over MMF cable.

With DMD, a single laser light pulse excites a few modes equally within an MMF cable. These modes, or light pathways, then follow two or more different paths. These paths might have different lengths and transmission delays as the light travels through the cable. With DMD, a distinct pulse propagating down the cable no longer remains a distinct pulse or, in extreme cases, might become two independent pulses. Strings of pulses can interfere with each other making it difficult to recover data.

DMD does not occur in all deployed fibers; it occurs with certain combinations of worst-case fibers and worst-case transceivers. Gigabit Ethernet experiences this problem because of its very high baud rate and its long MMF cable lengths. SMF cable and copper cable are not affected by DMD.

MMF cable has been tested for use only with LED sources. LEDs can create an *overfilled launch condition* within the fiber-optic cable. The overfilled launch condition describes the way LED transmitters couple light into the fiber-optic cable in a broad spread of modes. Similar to a light bulb radiating light into a dark room, the generated light that shines in multiple directions can overfill the existing cable space and excite a large number of modes. (See Figure 2-3.)

Figure 2-3 LED Transmission Compared to Laser Transmission



Lasers launch light in a more concentrated fashion. A laser transmitter couples light into only a fraction of the existing modes or optical pathways present in the fiber-optic cable. (See Figure 2-3.)

The solution is to condition the laser light launched from the source (transmitter) so it spreads the light evenly across the diameter of the fiber-optic cable making the launch look more like an LED source to the cable. The objective is to scramble the modes of light to distribute the power more equally in all modes and prevent the light from being concentrated in just a few modes.

An unconditioned launch, in the worst case, might concentrate all of its light in the center of the fiber-optic cable, exciting only two or more modes equally.

A significant variation in the amount of DMD is produced from one MMF cable to the next. No reasonable test can be performed to survey an installed cable plant to assess the effect of DMD. Therefore, you must use the mode-conditioning

patch cords for all uplink modules using MMF when the link span exceeds 984 feet (300 meters). For link spans less than 300 meters, you can omit the patch cord (although there is no problem using it on short links).

**Note**

For link spans greater than 328 feet (100 meters) but less than 984 feet (300 meters), you can omit the patch cord. We do not recommend using the LX/LH GBIC and MMF without a patch cord for short link distances less than 328 feet (100 meters). The result could be an elevated bit error rate (BER).

Console Port Cabling Specifications—Supervisor Engine Only

This section describes the console port cabling specifications for the supervisor engine.

**Note**

The accessories kit that shipped with your switch contains the necessary cable and adapters to connect a terminal or modem to the front-panel console port of the supervisor engine. These cables and adapters are the same as those shipped with the Cisco 2500 series routers and other Cisco products.

The supervisor engine front-panel console port mode switch allows you to connect a terminal or modem to the console port using the cable and adapters provided or you can connect your terminal using a Catalyst 5000 family Supervisor Engine III cable (not provided).

Table 2-10 lists the maximum transmission distances for console port cables. See Appendix A, “Technical Specifications” for console port and cable pinout information.

Table 2-10 EIA/TIA-232 Transmission Speed Versus Distance

Rate (bps)	Distance (feet)	Distance (meters)
2400	200	60
4800	100	30
9600	50	15
19,200	25	7.6
38,400	12	3.7
56,000	8.6	2.6

Port Connector Requirements—Switching Modules Only

You need these connector types to cable to the switching ports:

- SC connectors for GBICs. (See Figure 2-4.)



Note

When you plug the SC connector into the GBIC, make sure that both the Tx and Rx fiber-optic cables are fully inserted into the SC connector.



Note

If you are using the LX/LH GBIC with MMF, you need to install a patch cord between the GBIC and the MMF cable. See the “Patch Cord” section on page 2-9 for details.

- RJ-45 male connectors for the 48-port 10/100BASE-T RJ-45 module. (See Figure 2-5.)

- MT-RJ fiber-optic connectors for the 24-port 100BASE-FX module. (See Figure 2-6.)
- LC connectors for the SFP optical transceivers installed in the Supervisor Engine 720. (See Figure 2-7.)
- RJ-21 telco connectors for the 48-port 10/100BASE-T R J-21 telco module. (See Figure 2-8.)

Figure 2-4 SC Fiber-Optic Cable Connector

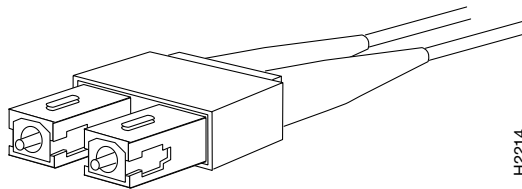


Figure 2-5 RJ-45 Interface Cable Connector

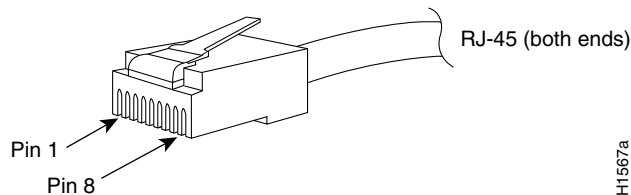


Figure 2-6 MT-RJ Fiber-Optic Cable Connector

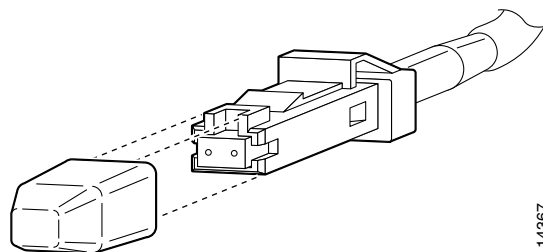
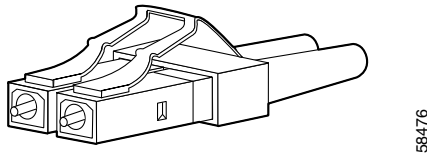
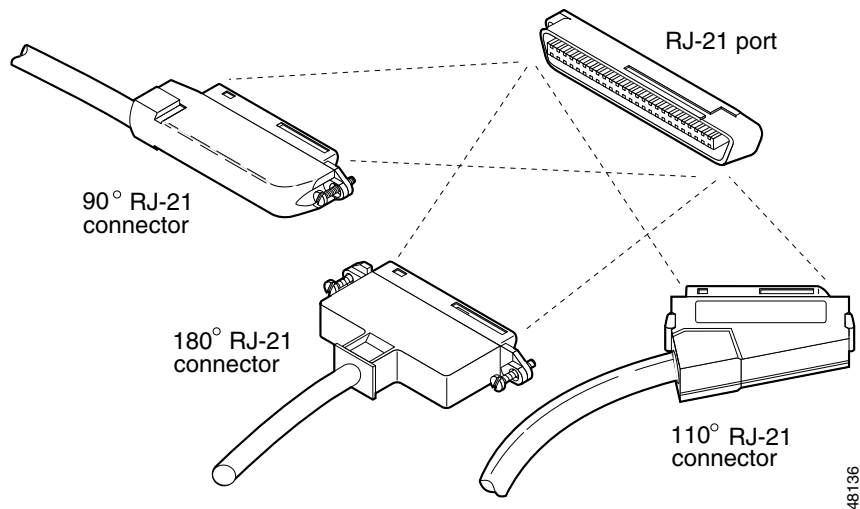


Figure 2-7 LC Fiber-Optic Connector**Figure 2-8 RJ-21 Telco Interface Cable Connectors**

Port Densities

Table 2-11 lists the bandwidth and port densities of the Catalyst 6000 series and Catalyst 6500 series switches.

Table 2-11 Catalyst 6000 Series and Catalyst 6500 Series Bandwidth and Port Density

Architecture	Catalyst 6000 Series Switch	Catalyst 6500 Series Switch¹
Backplane Bandwidth	32 Gbps	32 to 256 Gbps ²
Number of Gigabit Ethernet ports	82 (6 slots) Catalyst 6006 switch 130 (9 slots) Catalyst 6009 switch	34 (3 slots) Catalyst 6503 switch 82 (6 slots) Catalyst 6506 switch 130 (9 slots) Catalyst 6509 switch 192 (13 slots) Catalyst 6513 switch
Number of 100BASE-FX Ethernet ports	120 (6 slots) Catalyst 6006 switch 192 (9 slots) Catalyst 6009 switch	48 (3 slots) Catalyst 6503 switch 120 (6 slots) Catalyst 6506 switch 192 (9 slots) Catalyst 6509 switch 288 (13 slots) Catalyst 6513 switch
Number of 10/100 Ethernet ports	240 (6 slots) Catalyst 6006 switch 384 (9 slots) Catalyst 6009 switch	96 (3 slots) Catalyst 6503 switch 240 (6 slots) Catalyst 6506 switch 384 (9 slots) Catalyst 6509 switch 576 (13 slots) Catalyst 6513 switch
Number of 10BASE-FL Ethernet ports	120 (6 slots) Catalyst 6006 switch 192 (9 slots) Catalyst 6009 switch	48 (3 slots) Catalyst 6503 switch 120 (6 slots) Catalyst 6506 switch 192 (9 slots) Catalyst 6509 switch 288 (13 slots) Catalyst 6513 switch

Table 2-11 Catalyst 6000 Series and Catalyst 6500 Series Bandwidth and Port Density (continued)

Architecture	Catalyst 6000 Series Switch	Catalyst 6500 Series Switch ¹
Number of ATM OC-12 ports	5 (6 slots) Catalyst 6006 switch 8 (9 slots) Catalyst 6009 switch	2 (3 slots) Catalyst 6503 switch 5 (6 slots) Catalyst 6506 switch 8 (9 slots) Catalyst 6509 switch 12 (13 slots) Catalyst 6513 switch
Number of FlexWAN Modules	5 (6 slots) Catalyst 6006 switch 8 (9 slots) Catalyst 6009 switch	2 (3 slots) Catalyst 6503 switch 5 (6 slots) Catalyst 6506 switch 8 (9 slots) Catalyst 6509 switch 12 (13 slots) Catalyst 6513 switch

1. Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.
2. If you have backplane bandwidth greater than 32 Gbps, you must install a Switch Fabric Module or install a Supervisor Engine 720 in the Catalyst 6500 series switch chassis.

Gigabit Interface Converters

A Gigabit Interface Converter (GBIC) is a hot-swappable input/output device that plugs into a supervisor engine or Gigabit Ethernet module which links the module with the fiber-optic network or with the copper network.

This section contains these topics:

- WS-G5483 Copper GBIC, page 2-19
- WS-G5484, WS-G5486, and WS-G5487 Optical GBICs, page 2-20
- Coarse Wave Division Multiplexing GBICs, page 2-21

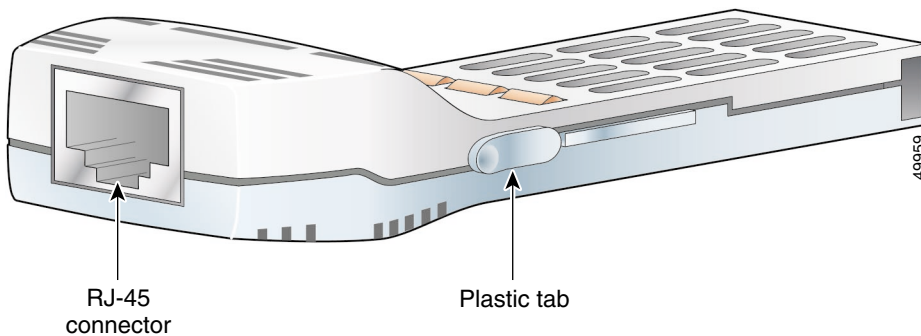
WS-G5483 Copper GBIC

The WS-G5483 GBIC uses Category 5, Category 5e, or Category 6 UTP/FTP cable to provide 1000BASE-T full-duplex connectivity between the Gigabit Ethernet module or supervisor engine and the network up to a distance of 328 feet (100 meters). (See Figure 2-9.) Refer to your release notes or the online *1000BASE-T GBIC Switch Compatibility Matrix* posted with the GBIC documentation on Cisco.com for the list of modules and the required software release level necessary to support this GBIC.

**Caution**

To comply with GR-1089 intrabuilding, lightening-immunity requirements, you must use foil-twisted pair (FTP) cable that is properly grounded at both ends.

Figure 2-9 Copper GBIC (WS-G5483)



WS-G5484, WS-G5486, and WS-G5487 Optical GBICs

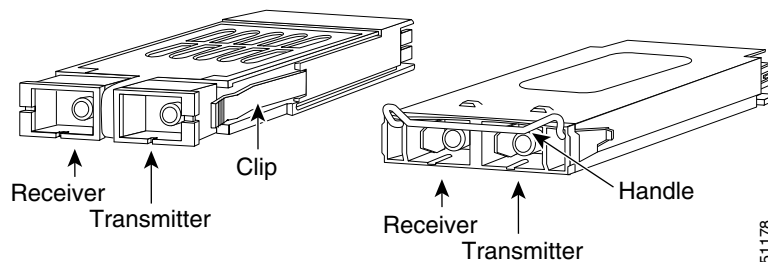
Table 2-12 lists the three types of optical GBICs.

Table 2-12 Optical GBIC Model List

Product Number	GBIC
WS-G5484	Short wavelength (1000BASE-SX)
WS-G5486	Long wavelength/long haul (1000BASE-LX/LH)
WS-G5487	Extended distance (1000BASE-ZX)

Each of the three types of optical GBICs comes in two physical models shown in Figure 2-10. These two physical models require different installation procedures.

Figure 2-10 Optical GBIC Physical Styles (WS-G5484, WS-G5486, and WS-G5487)

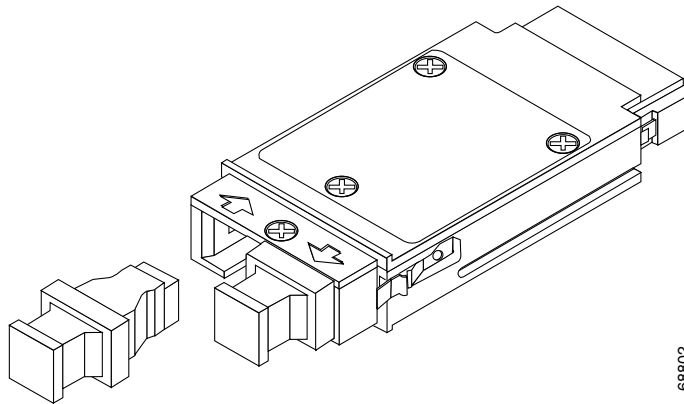


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Coarse Wave Division Multiplexing GBICs

Eight GBICs are available for use with the CWDM Passive Optical System. (See Figure 2-11.) Table 2-13 lists the available GBICs. These eight GBICs are installed in the Catalyst 6500 series modules that support GBICs and are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the Cisco CWDM Passive Optical System*.

Figure 2-11 CWDM GBIC



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Table 2-13 CWDM GBICs

Model Number	CWDM GBIC Wavelength
CWDM-GBIC-1470=	1470 nm laser, single mode
CWDM-GBIC-1490=	1490 nm laser, single mode
CWDM-GBIC-1510=	1510 nm laser, single mode
CWDM-GBIC-1530=	1530 nm laser, single mode
CWDM-GBIC-1550=	1550 nm laser, single mode
CWDM-GBIC-1570=	1570 nm laser, single mode
CWDM-GBIC-1590=	1590 nm laser, single mode
CWDM-GBIC-1610=	1610 nm laser, single mode

SFP Optical Transceiver Modules

Small Form-Factor Pluggable (SFP) optical transceiver modules are hot-pluggable and field-replaceable, and you can insert them into SFP module slots on the front panel of the Supervisor Engine 720 and the WS-X6724-SFP Gigabit Ethernet module. The SFP optical transceiver modules use an LC connector.

You can use any combination of SFP modules that your Cisco device supports. The only restrictions are that each SFP port must match the wavelength specifications on the other end of the cable and that the cable must not exceed the stipulated cable length for reliable communications.

Figure 2-12 SFP Optical Transceiver Module

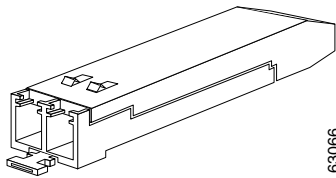


Table 2-14 SFP Optical Transceiver Module Cabling Specifications

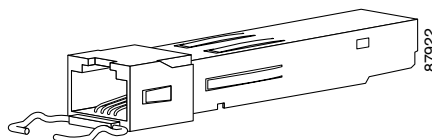
SFP Module	Wavelength (nanometers)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Cable Distance
1000BASE-SX (GLC-SX-MM)	850	MMF	62.5	160	722 feet (220 m)
			62.5	200	902 feet (275 m)
			50.0	400	1640 feet (500 m)
			50.0	500	1804 feet (550 m)
1000BASE-LX/LH (GLC-LH-SM)	1300	MMF ¹	62.5	500	1804 feet (550 m)
			50.0	400	1804 feet (550 m)
		SMF	50.0	500	1804 feet (550 m)
			9/10	—	32,810 feet (10 km)
1000BASE-ZX (GLC-ZX-SM)	1550	SMF	9/10	—	43.4 to 62 miles (70 to 100 km) ²

1. A mode-conditioning patch cord is required. Using an ordinary patch cord with MMF, 1000BASE-LX/LH SFP modules, and a short link distance can cause transceiver saturation, resulting in an elevated bit error rate (BER). When using the LX/LH SFP module with 62.5-micron diameter MMF, you must also install a mode-conditioning patch cord between the SFP module and the MMF cable on both the sending and receiving ends of the link. The mode-conditioning patch cord is required for link distances greater than 984 feet (300 m).
2. 1000BASE-ZX SFP modules can reach up to 100 km by using dispersion-shifted SMF or low-attenuation SMF; the distance depends on the fiber quality, the number of splices, and the connectors.

1000BASE-T SFP Modules

The 1000BASE-T SFP transceiver modules provide Category 5, Category 5e, and Category 6 support for SFP modules. The 1000BASE-T SFP transceiver modules use standard four twisted-pair cable at lengths up to 328 feet (100 meters) and have standard RJ-45 connectors. Figure 2-13 shows a 1000BASE-T SFP module.

Figure 2-13 1000BASE-T SFP Transceiver Module



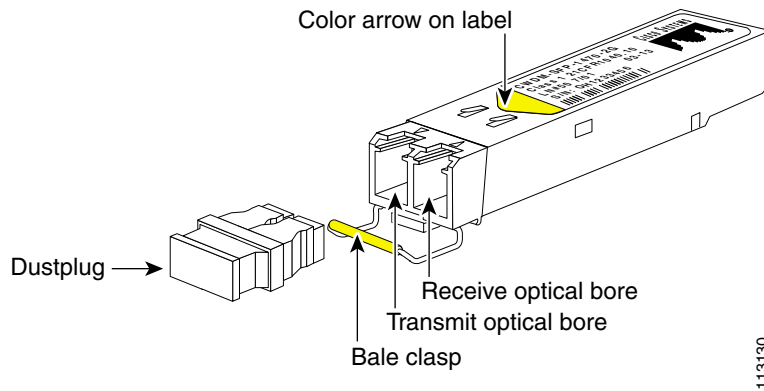
CWDM SFP Optical Transceiver Modules

The Coarse Wavelength Division Multiplexing (CWDM) SFPs are hot-swappable, transceiver components that you can plug into standard receptacles in switching modules that convert Gigabit Ethernet electrical signals into a single-mode fiber-optic (SMF) interface. You can connect the CWDM SFPs to CWDM passive optical system optical add/drop multiplexer (OADM) modules or multiplexer/demultiplexer plug-in modules using single-mode fiber-optic cables with standard SC connectors. Table 2-15 lists the available CWDM SFP wavelengths and color-coding identifier.

Table 2-15 CWDM SFP Optical Transceiver Models

CWDM SFP Product Number	Wavelength	Color
CWDM-SFP-1470	Longwave 1470 nm laser, single mode	Gray
CWDM-SFP-1490	Longwave 1490 nm laser, single mode	Violet
CWDM-SFP-1510	Longwave 1510 nm laser, single mode	Blue
CWDM-SFP-1530	Longwave 1530 nm laser, single mode	Green
CWDM-SFP-1550	Longwave 1550 nm laser, single mode	Yellow
CWDM-SFP-1570	Longwave 1570 nm laser, single mode	Orange
CWDM-SFP-1590	Longwave 1590 nm laser, single mode	Red
CWDM-SFP-1610	Longwave 1610 nm laser, single mode	Brown

Figure 2-14 shows a CWDM SFP with the optical port dust plug removed.

Figure 2-14 CWDM SFP Optical Transceiver Module

XenPak Optical Transceiver Modules

The XenPak optical transceiver modules are hot-swappable, transceiver components that you can plug into standard receptacles in modules that convert Gigabit Ethernet electrical signals into a single-mode fiber-optic (SMF) interface. Figure 2-15 shows a XenPak optical transceiver module.

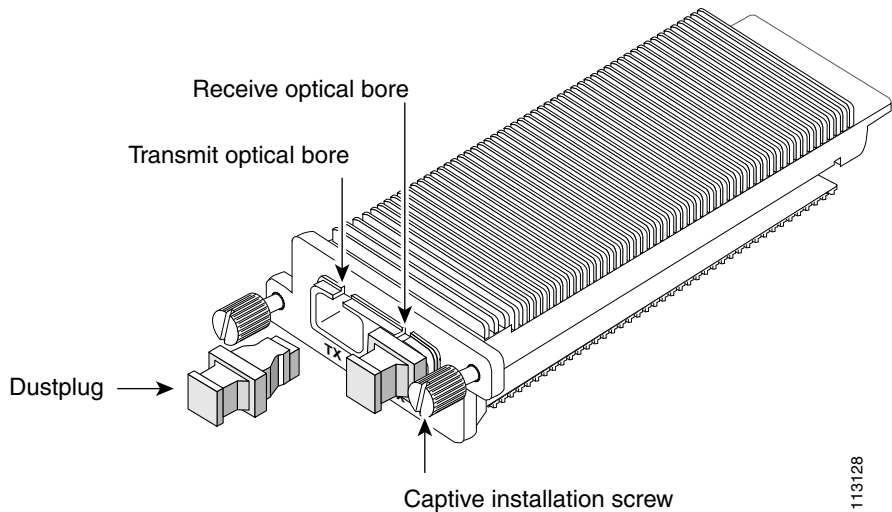
Figure 2-15 XenPak Optical Transceiver Module

Table 2-16 lists the available XenPak transceiver modules and their specifications.

Table 2-16 XenPak Optical Transceiver Specifications

XenPak	Wavelength	Connector and Cable Type	Maximum Distance
XENPAK-10GB-LR	1310 nm	SC; SMF	6.2 miles (10 km)
XENPAK-10GB-ER	1550 nm	SC; SMF	24.85 miles (40 km)

Software Requirements

For information on the minimum, recommended, and default software versions for the Catalyst 6000 series and Catalyst 6500 series switches, supervisor engines, and modules, refer to the applicable release notes for the latest maintenance release of your software.



Installing the Module

This chapter describes how to install and verify the operation of the supervisor engine and switching modules in the Catalyst 6500 series switches, and it contains these sections:

- Required Tools, page 3-2
- Installing a Supervisor Engine or a Switching Module, page 3-2
- Removing the Supervisor Engine or a Switching Module, page 3-12
- Connecting to the Console Port—Supervisor Engine Only, page 3-15
- Connecting to the Uplink Ports—Supervisor Engine Only, page 3-16
- Using Flash PC Cards, page 3-17
- Verifying the Installation, page 3-19
- What To Do After Installing Modules and Verifying Connectivity, page 3-22



Warning

Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030



Warning

Before opening the unit, disconnect the telephone-network cables to avoid contact with telephone-network voltages. Statement 1041

**Warning**

During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself. Statement 93

Required Tools

This section describes the tools that you need to install the supervisor engine or switching modules.

These tools are required to install switching modules in the chassis:

- Small flat-blade screwdriver
- No. 2 Phillips screwdriver
- Wrist strap or other grounding device
- Antistatic mat or antistatic foam

Installing a Supervisor Engine or a Switching Module

**Note**

Before installing switching modules, you must install the switch chassis and at least one supervisor engine. For information on installing the switch chassis, refer to the *Catalyst 6000 Series Switch Installation Guide* or the *Catalyst 6500 Series Switch Installation Guide*.

This section describes how to install a supervisor engine in the chassis. Supervisor engines must be installed in specific slots in the chassis depending on which model of supervisor engine you are installing. Table 3-1 lists the specific slot assignments for the different supervisor engine models.

Table 3-1 Supervisor Engine Slot Assignments

Supervisor Engine	Slot Assignments
Supervisor Engine 1A	• Slots 1 and 2 (3-slot chassis) • Slots 1 and 2 (6-slot chassis) • Slots 1 and 2 (9-slot chassis)
Supervisor Engine 2	• Slots 1 and 2 (3-slot chassis) • Slots 1 and 2 (6-slot chassis) • Slots 1 and 2 (9-slot chassis) • Slots 1 and 2 (13-slot chassis)
Supervisor Engine 720	• Slots 1 and 2 (3-slot chassis) • Slots 5 and 6 (6-slot chassis) • Slots 5 and 6 (9-slot chassis) • Slots 7 and 8 (13-slot chassis)

You should install switching-module filler plates (Cisco part number 800-00292-01) in any empty slots to maintain consistent airflow through the switch chassis.

**Caution**

To prevent ESD damage, handle modules by the carrier edges only.

**Caution**

During this procedure, wear grounding wrist straps to avoid ESD damage to the module.

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

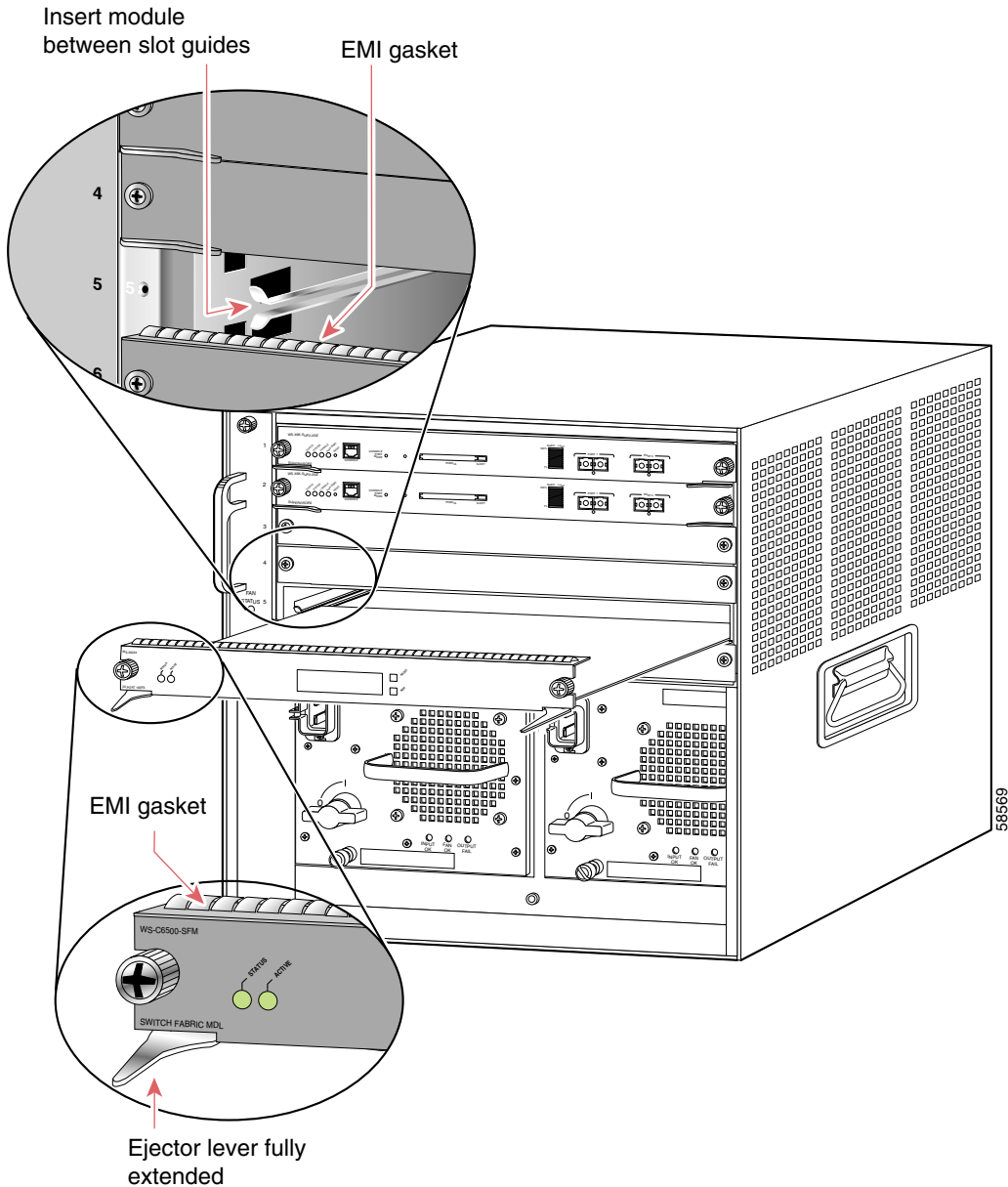
To install a supervisor engine or module in the chassis, follow these steps:

-
- Step 1** Choose a slot for the supervisor engine or module.
- Step 2** Verify that there is enough clearance to accommodate any interface equipment that you will connect directly to the supervisor engine or module ports. If possible, place modules between empty slots that contain only module filler plates.
- Step 3** Verify that the captive installation screws are tightened on all modules installed in the chassis. This action assures that the EMI gaskets on all modules are fully compressed in order to maximize the opening space for the new or replacement module.



Note If the captive installation screws are loose, the EMI gaskets on the installed modules will push adjacent modules toward the open slot, reducing the opening size and making it difficult to install the replacement module.

- Step 4** Remove the module filler plate by removing the two Phillips pan-head screws from the filler plate. To remove a module, refer to “Removing the Supervisor Engine or a Switching Module” section on page 3-12.
- Step 5** Fully open both ejector levers on the new or replacement module. (See Figure 3-1.)

Figure 3-1 Positioning the Module in a Horizontal Slot Chassis

- Step 6** Depending on the orientation of the slots in the chassis (horizontal or vertical), perform one of the following two sets of steps:

Horizontal slots

- a. Position the supervisor engine or module in the slot. (See Figure 3-1.) Make sure that you align the sides of the module carrier with the slot guides on each side of the slot.
- b. Carefully slide the supervisor engine or module into the slot until the EMI gasket along the top edge of the module makes contact with the module in the slot above it and both ejector levers have closed to approximately 45 degrees with respect to the module faceplate. (See Figure 3-2.)
- c. Using the thumb and forefinger of each hand, grasp the two ejector levers and press down to create a small 0.040 inch (1 mm) gap between the module's EMI gasket and the module above it. (See Figure 3-2.)



Note Do not press down too forcefully on the levers because they will bend and get damaged.

- d. While pressing down, simultaneously close the left and right ejector levers to fully seat the supervisor engine or module in the backplane connector. The ejector levers are fully closed when they are flush with the module faceplate. (See Figure 3-3.)



Note Failure to fully seat the module in the backplane connector can result in error messages.

- e. Tighten the two captive installation screws on the supervisor engine or module.

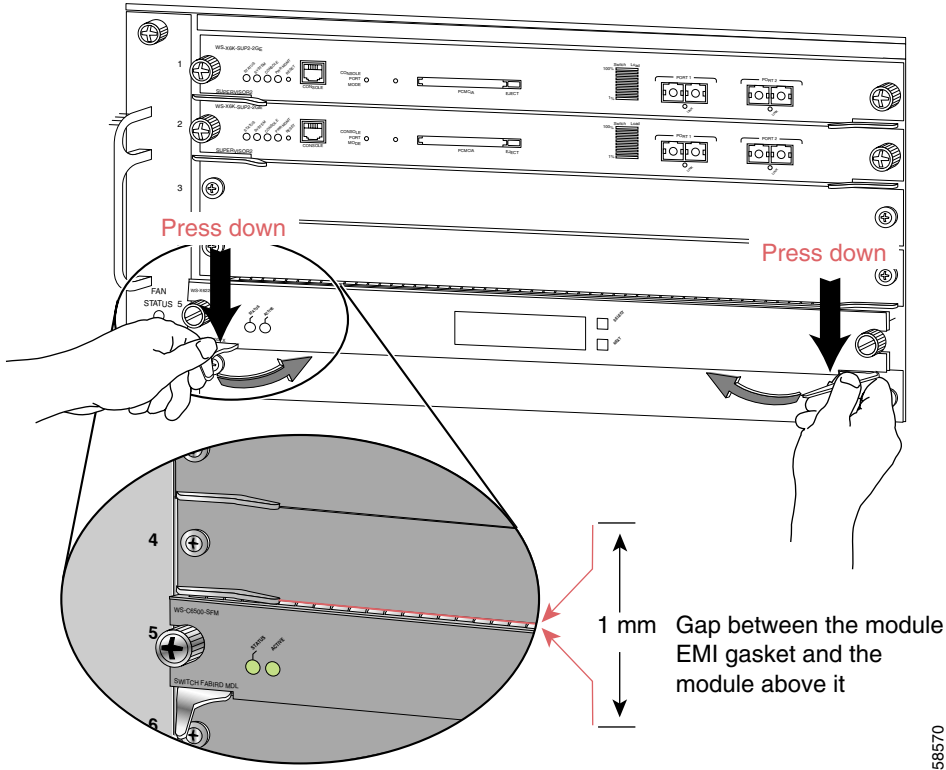


Note Make sure the ejector levers are fully closed before tightening the captive installation screws.

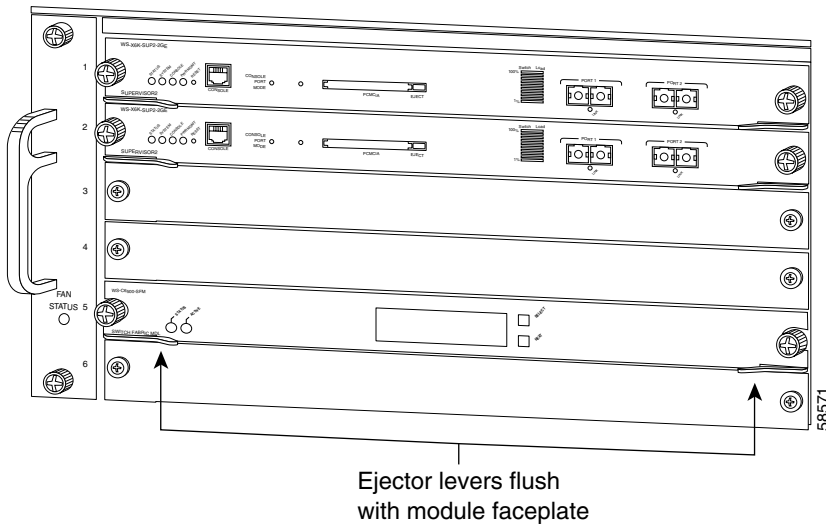
- f. Verify that the supervisor engine or module STATUS LED is lit. Periodically, check the STATUS LED. If the STATUS LED changes from orange to green, the supervisor engine or module has successfully completed the boot process and is now online. If the STATUS LED remains orange or turns red, the

supervisor engine or module has not successfully completed the boot process and may have encountered an error. For more information about the orange or red STATUS LED states, see the LED table for your specific module in Chapter 1.

Figure 3-2 *Clearing the EMI Gasket in a Horizontal Slot Chassis*



58570

Figure 3-3 Closing the Ejector Levers in a Horizontal Slot Chassis

Vertical slots

- a. Position the supervisor engine or switching module in the slot. (See Figure 3-4.) Make sure that you align the sides of the switching-module carrier with the slot guides on the top and bottom of the slot.
- b. Carefully slide the supervisor engine or module into the slot until the EMI gasket along the right edge of the module makes contact with the module in the slot adjacent to it and both ejector levers have closed to approximately 45 degrees with respect to the module faceplate. (See Figure 3-5.)

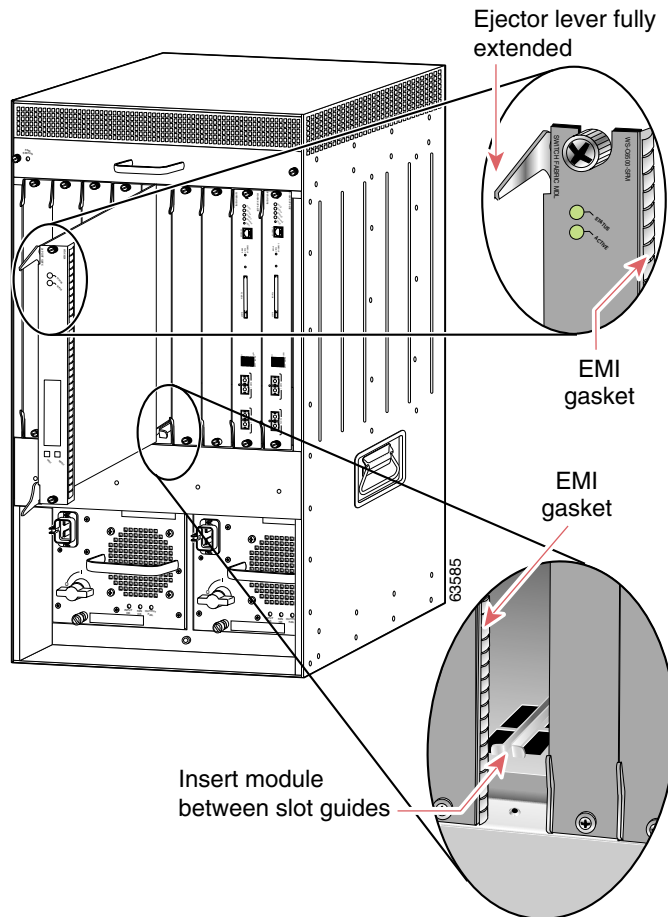
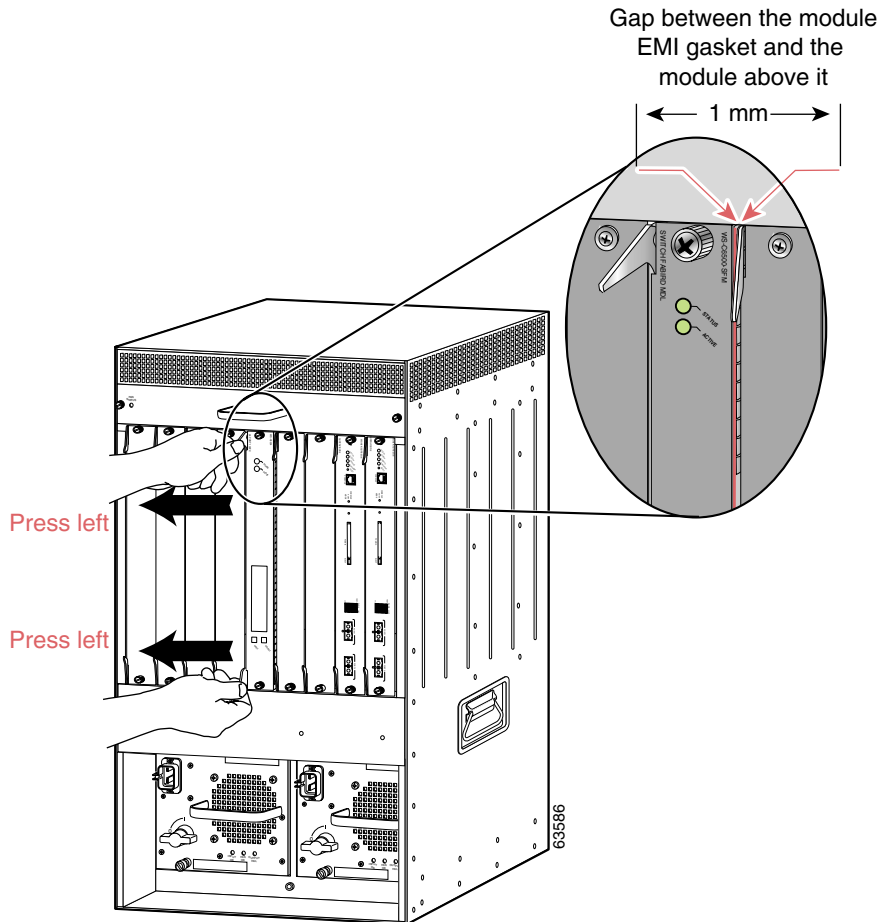
Figure 3-4 Positioning the Module in a Vertical Slot Chassis

Figure 3-5 Clearing the EMI Gasket in a Vertical Slot Chassis

- c. Using the thumb and forefinger of each hand, grasp the two ejector levers and exert a slight pressure to the left, deflecting it approximately 0.040 inches (1 mm) creating a small gap between the module's EMI gasket and the module adjacent to it. (See Figure 3-5.)

**Note**

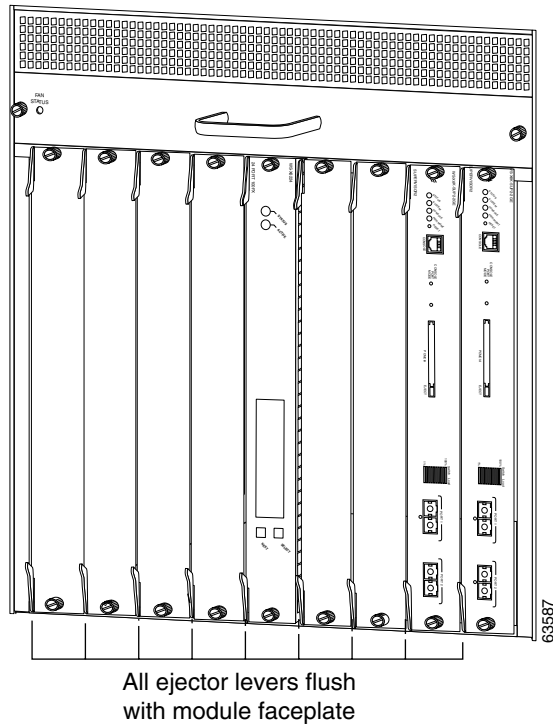
Do not exert too much pressure on the ejector levers because they will bend and get damaged.

- d. While pressing down on the ejector levers, simultaneously close the levers to fully seat the supervisor engine or module in the backplane connector. The ejector levers are fully closed when they are flush with the module faceplate. (See Figure 3-6.)
- e. Tighten the two captive installation screws on the module.

**Note**

Make sure that the ejector levers are fully closed before tightening the captive installation screws.

- f. Verify that the supervisor engine or module STATUS LED is lit. Periodically, check the STATUS LED. If the STATUS LED changes from orange to green, the supervisor engine or module has successfully completed the boot process and is now online. If the STATUS LED remains orange or turns red, the supervisor engine or module has not successfully completed the boot process and may have encountered an error. For more information about the orange or red STATUS LED states, see the LED table for your specific module in Chapter 1.

Figure 3-6 Closing the Ejector Levers in a Vertical Slot Chassis

Removing the Supervisor Engine or a Switching Module

This section describes how to remove a supervisor engine or a switching module from the Catalyst 6500 series switch.

Before you remove a supervisor engine, you should first upload the current configuration to a server using the **write {host file | network | terminal}** command. This step saves time when bringing the module back online. You can recover the configuration by downloading it from the server to the nonvolatile memory of the supervisor engine.

**Tip**

When you install a new supervisor engine, check the factory default configuration; you might need to reconfigure the system to your requirements. You can reconfigure the supervisor engine manually, or if you previously uploaded the original configuration to a server, you can download it to the new supervisor engine. Refer to the *Catalyst 6500 Series Switch Software Configuration Guide* or to the *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide* for additional information.

This section describes how to remove an existing module from a chassis slot.

**Caution**

During this procedure, wear grounding wrist straps to avoid ESD damage to the module.

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

To remove a supervisor engine or module from the chassis, perform these steps:

- Step 1** Disconnect any network interface cables attached to the supervisor engine or module.
- Step 2** Verify that the captive installation screws on all of the modules in the chassis are tight. This step ensures that the space created by the removed module is maintained.

**Note**

If the captive installation screws are loose, the EMI gaskets on the installed modules will push the modules toward the open slot, reducing the opening size and making it difficult to install the replacement module.

- Step 3** Loosen the two captive screws on the supervisor engine or module.
- Step 4** Depending on the orientation of the slots in the chassis (horizontal or vertical), perform one of the following two sets of steps:

Horizontal slots

- a. Place your thumbs on the left and right ejector levers and simultaneously rotate the levers outward to unseat the module from the backplane connector.
- b. Grasp the front edge of the module and slide the module part of the way out of the slot. Place your other hand under the module to support the weight of the module. Do not touch the module circuitry.

Vertical slots

- a. Place your thumbs on the ejector levers located at the top and bottom of the module, and simultaneously rotate the levers outward to unseat the module from the backplane connector.
 - b. Grasp the edges of the module, and slide the module straight out of the slot. Do not touch the module circuitry.
- Step 5** Place the module on an antistatic mat or antistatic foam, or immediately reinstall it in another slot.
- Step 6** If the slot is to remain empty, install a module filler plate to keep dust out of the chassis and to maintain proper airflow through the chassis.
-

**Warning**

Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.

Statement 1029

Connecting to the Console Port—Supervisor Engine Only

This section describes how to connect to the supervisor engine CONSOLE port from a terminal or modem.

The CONSOLE port, located on the front panel of the supervisor engine, is shown in Figure 3-7.

This section contains the following topics:

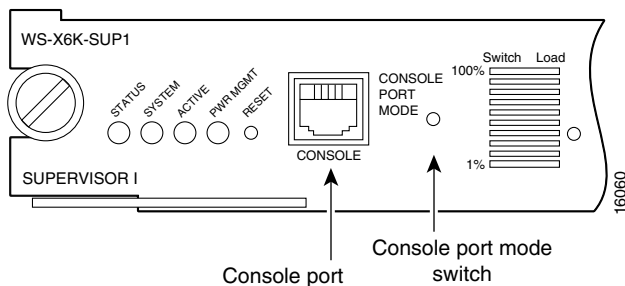
- Connecting a Terminal, page 3-15
- Connecting a Modem, page 3-16



Note

The accessories kit that shipped with your switch contains the necessary cable and adapters to connect a terminal or modem to the CONSOLE port.

Figure 3-7 Supervisor Engine Console Port Connector



Connecting a Terminal

To connect a terminal to the CONSOLE port using the cable and adapters provided, place the CONSOLE PORT MODE switch in the *in* position (factory default). Connect to the port using the RJ-45-to-RJ-45 cable and RJ-45-to-DB-25 DTE adapter or RJ-45-to-DB-9 data terminal equipment (DTE) adapter (labeled “Terminal”).

To connect a terminal using a Catalyst 5000 family Supervisor Engine III console cable, place the CONSOLE PORT MODE switch in the *out* position. Connect to the port using the Supervisor Engine III cable and the appropriate adapter for the terminal connection.

Check the terminal documentation to determine the baud rate. The baud rate of the terminal must match the default baud rate (9600 baud) of the console port. Set up the terminal as follows:

- 9600 baud
- 8 data bits
- No parity
- 2 stop bits

Connecting a Modem

To connect a modem to the console port, place the CONSOLE PORT MODE switch in the *in* position. Connect to the port using the RJ-45-to-RJ-45 cable and the RJ-45-to-DB-25 data communications equipment (DCE) adapter (labeled “Modem”).

Connecting to the Uplink Ports—Supervisor Engine Only

This section describes how to connect to the supervisor engine uplink ports.



Note

In a redundant configuration with two supervisor engines, the uplink ports on the redundant (standby) supervisor engine are active and can be used for normal traffic like any other ports in the chassis.



Warning

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

To connect to the supervisor engine uplink ports, follow these steps:

-
- Step 1** Remove the plugs from the GBIC or SFP optical bores and store them for future use.
- Step 2** Remove the plugs from the connector on the fiber-optic cable.

GBICs installed in the Supervisor Engine 1 and the Supervisor Engine 2 use SC connectors. SFP optical transceivers installed in the Supervisor Engine 720 use either MT-RJ connectors or LC connectors.

- Step 3** Insert the cable connector into the GBIC or SFP, making sure that both the transmit (Tx) and receive (Rx) fiber-optic cables are fully inserted into the SC connector.



Note If you are using the LX/LH GBIC with MMF, you need to install a patch cord between the GBIC and the MMF cable. See the “Patch Cord” section on page 2-9 for details.



Caution

Do not remove the plugs from the GBIC or SFP optical bores or the fiber-optic cable until you are ready to connect the cable. The plugs protect the GBIC and SFP optical bores and cable from contamination.

For GBIC installation information, refer to the *Gigabit Interface Converter Installation Note*. For SFP installation information, refer to the *Cisco Small Form-Factor Pluggable Module Installation Notes*.

Using Flash PC Cards



Note

Supervisor Engine 1 and Supervisor Engine 2 do not support the same Flash PC card format. To use a Flash PC card with Supervisor Engine 2, you must format the card with Supervisor Engine 2. To use a Flash PC card with Supervisor Engine 1, you must format the card with Supervisor Engine 1.

This section describes how to insert and remove a (PCMCIA) Flash PC card. For additional information related to the Flash PC card, refer to the *Catalyst 6500 Series Switch Software Configuration Guide* or the *Catalyst 6500 Series Switch IOS Software Configuration Guide*.

The PCMCIA slot on the front panel of the supervisor engine is for additional Flash memory. You can use this Flash memory to store and run software images and configuration files or to serve as an I/O device.

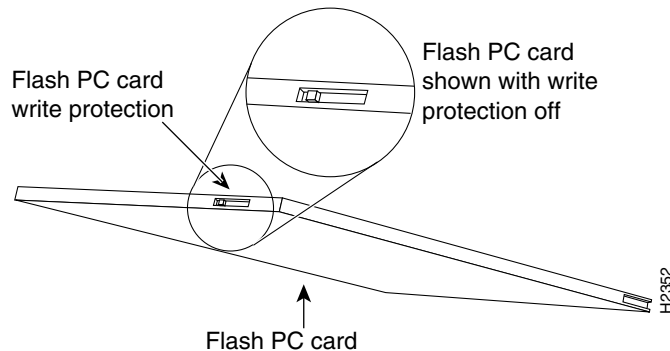
The supervisor engine has one PCMCIA slot: slot 0. You can insert and remove the Flash PC card with the power on.

Before you install a Flash PC card, verify that the card is set with write protection off. The write-protect switch is located on the front edge of the card (when the printing is right side up and the edge connector end is away from you). (See Figure 3-8.)

**Note**

Not all Flash PC cards have the write-protect switch.

Figure 3-8 Locating the Flash PC Card Write-Protection Switch



Installing and Removing a Flash PC Card

To install and remove a Flash PC card, follow these steps:

Step 1 Face the front panel of the switch and hold the Flash PC card with the connector end of the card toward the slot. The connector end of the card is opposite the end with the write-protection switch, which is shown in Figure 3-8.

Step 2 Insert the card into the slot until the card completely seats in the connector at the back of the slot and the eject button pops out toward you. Note that the card does not insert all the way inside the slot; a portion of the card remains outside the slot.



Caution

Do not attempt to force the card past this point or you could damage the connector pins.

Step 3 To eject a card, press the ejector button until the card is free of the connector at the back of the slot.

Step 4 Remove the card from the slot and place it in an antistatic bag.

For information on installing and removing a CompactFlash card or MicroDrive on a Supervisor Engine 720, refer to the *Supervisor Engine 720 Compact Flash and MicroDrive Installation Note*.

Verifying the Installation

This section describes how to verify the installation of a supervisor engine or switching module.

To verify the installation of a Catalyst 6500 series switch running Cisco IOS software, refer to the *Catalyst 6500 Series Switch IOS Software Configuration Guide*.

This section contains the following topics:

- Verifying Newly Installed Modules, page 3-20
- Checking Connectivity, page 3-22

Verifying Newly Installed Modules

Enter the **show module** or **show port** [*mod_num/port_num*] command to verify that the system acknowledges the new modules and has brought them online.

This example shows the output of the **show module** command:

```

Console> show module
Mod Slot Ports Module-Type          Model          Sub Status
-----
1   1   2   1000BaseX Supervisor      WS-X6K-SUP1A-2GE  yes ok
15  1   1   Multilayer Switch Feature WS-F6K-MSFC       no ok
3   3   2   Network Analysis Module  WS-X6380-NAM      no ok
5   5   48  10/100BaseTX Ethernet    WS-X6248-RJ-45    no ok

Mod Module-Name          Serial-Num
-----
1   SAD03392376
15  SAD03366264
3   JAB0343055Y
5   SAD03181291

Mod MAC-Address(es)      Hw   Fw   Sw
-----
1   00-30-96-29-9f-84 to 00-30-96-29-9f-85 1.0   5.2(1) 6.1(0.128)ORL
    00-30-96-29-9f-86 to 00-30-96-29-9f-87
    00-50-3e-8d-64-00 to 00-50-3e-8d-67-ff
15  00-d0-bc-ed-6b-2c to 00-d0-bc-ed-6b-6b 1.2   12.0(7T)XE 12.0(7T)XE1(2.07)
3   00-90-2b-00-a7-ca to 00-90-2b-00-a7-cb 0.201 4B4LZ0XA 1.1(0.20)
5   00-50-f0-ac-30-54 to 00-50-f0-ac-30-83 1.0   4.2(0.24)V 6.1(0.128)ORL

```

Mod	Sub-Type	Sub-Model	Sub-Serial	Sub-Hw
1	L3 Switching Engine	WS-F6K-PFC	SAD03365068	1.0

Console>

This example shows the output of the **show port** command:

Console> **show port 1/1**

Port	Name	Status	Vlan	Duplex	Speed	Type
1/1		connected	1	full	1000	1000BaseSX

Port	Security	Secure-Src-Addr	Last-Src-Addr	Shutdown	Trap	IfIndex
1/1	disabled			No	disabled	3

Port	Broadcast-Limit	Broadcast-Drop
1/1	-	0

Port	Send FlowControl admin oper	Receive FlowControl admin oper	RxPause	TxPause
1/1	desired on	off off	0	0

Port	Status	Channel Mode	Admin Ch Group Id	Neighbor Device	Neighbor Port
1/1	connected	auto	123 0		

Port	Align-Err	FCS-Err	Xmit-Err	Rcv-Err	UnderSize
1/1	0	0	0	0	0

Port	Single-Col	Multi-Coll	Late-Coll	Excess-Col	Carri-Sen	Runts	Giants
1/1	0	0	0	0	23	0	0

Last-Time-Cleared

Fri March 2 2003, 20:41:52

Console>

Checking Connectivity

To check connectivity on any switching module port, perform these tasks:

Task	Command
• Ping a host.	ping <i>host</i>
• If the host is unresponsive, check the IP address of the switch and default IP route, if appropriate.	show interface show ip route

For example, to ping a host named server1, enter this command:

```
Console> ping server1
server1 is alive
Console>
```

What To Do After Installing Modules and Verifying Connectivity

After you verify the supervisor engine or switching module installation and check connectivity, you must configure the module. For complete information on configuring the supervisor engine and all modules, refer to the *Catalyst 6500 Series Switch Software Configuration Guide* or the *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide*. For information on all Catalyst 6500 series switch commands, refer to the *Catalyst 6500 Series Switch Command Reference* or the *Catalyst 6500 Series Switch Cisco IOS Command Reference* publications.



Technical Specifications



Note

In this appendix, the term Catalyst 6500 series modules refers to modules that can be installed in either the Catalyst 6000 series switch chassis (Catalyst 6006 and Catalyst 6009 switches) or the Catalyst 6500 series switch chassis (Catalyst 6503, Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB, and Catalyst 6513 switches) unless specifically noted.

This appendix provides the technical specifications for the Catalyst 6500 series modules.

Module Specifications

Table A-1 lists the environmental and physical specifications for the Catalyst 6500 series modules.

Table A-1 Environmental and Physical Specifications

Item	Specification
Environmental	
Temperature, ambient operating	32°F (0°C) to 104°F (40°C)
Temperature, ambient nonoperating and storage	−40°F (−40°C) to 167°F (75°C)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Altitude operating	−197 to 6500 ft (−60 to 2000 m)
Physical Characteristics	
Dimensions (H x W x D)	1.2 x 14.4 x 16 in (3.0 x 35.6 x 40.6 cm)
Weight	3 to 10 lb (1.4 to 4.5 kg)

Regulatory Standards Compliance

Catalyst 6500 series switches comply with the regulatory standards listed in the *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches* publication.



Cable and Connector Specifications

This appendix lists the cable and connector specifications for the Catalyst 6500 series modules. The following connectors and signal summaries are contained in this appendix:

- RJ-21 Connector, page B-2
- RJ-21 (WS-X6624-FXS Only), page B-4
- RJ-45 Connector, page B-5
- Supervisor Engine Console Port Signals and Pinouts, page B-8
- Fiber-Optic Connectors, page B-14

RJ-21 Connector

The RJ-21 data bus (DB-21) connectors connect Ethernet, Fast Ethernet, or phone connections to a punch-down block or a patch panel using Category 3, Category 5, Category 5e, or Category 6 UTP or FTP. (See Figure B-1.)



Note

Do not use Category 3 RJ-21 telco connectors and cables on the 48-port 10/100BASE-T switching module. If you use Category 3 RJ-21 connectors and cables, you will get carrier sense errors in your network. You must use Category 5, Category 5e, or Category 6 RJ-21 connectors and cables because the module's connectors are keyed for Category 5, Category 5e, or Category 6 connectors and cables.



Caution

Category 5e and Category 6 cables can store high levels of static electricity because of the dielectric properties of the materials used in their construction. Always ground the cables (especially in new cable runs) to a suitable and safe earth ground before connecting them to the module.

Figure B-1 RJ-21 Connectors

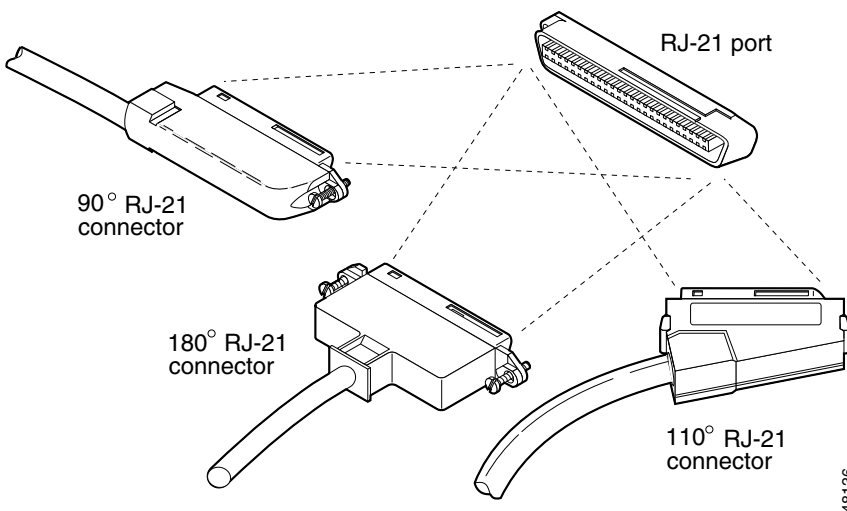


Table B-1 lists the output signals for the RJ-21 connector. The receive and transmit signals are polarized. One pin of each signal pair carries the positive (+) signal and one pin carries the negative (–) signal.

**Note**

Table B-1 lists the *output signals* for the RJ-21 connector, not the *pinouts* of the cable connecting to the module.

Table B-1 RJ-21 Connector Pinout

Ethernet Port No.	Connector Pin No.	Signal	Connector Pin No.	Signal
1	1	RxD (–)	26	RxD (+)
	2	TxD (–)	27	TxD (+)
2	3	RxD (–)	28	RxD (+)
	4	TxD (–)	29	TxD (+)
3	5	RxD (–)	30	RxD (+)
	6	TxD (–)	31	TxD (+)
4	7	RxD (–)	32	RxD (+)
	8	TxD (–)	33	TxD (+)
5	9	RxD (–)	34	RxD (+)
	10	TxD (–)	35	TxD (+)
6	11	RxD (–)	36	RxD (+)
	12	TxD (–)	37	TxD (+)
7	13	RxD (–)	38	RxD (+)
	14	TxD (–)	39	TxD (+)
8	15	RxD (–)	40	RxD (+)
	16	TxD (–)	41	TxD (+)
9	17	RxD (–)	42	RxD (+)
	18	TxD (–)	43	TxD (+)
10	19	RxD (–)	44	RxD (+)
	20	TxD (–)	45	TxD (+)
11	21	RxD (–)	46	RxD (+)
	22	TxD (–)	47	TxD (+)

Table B-1 RJ-21 Connector Pinout (continued)

Ethernet Port No.	Connector Pin No.	Signal	Connector Pin No.	Signal
12	23	RxD (–)	48	RxD (+)
	24	TxD (–)	49	TxD (+)
–	25	Gnd	50	Gnd

RJ-21 (WS-X6624-FXS Only)

Table B-2 lists the pinouts for the RJ-21 connector on the 24-port WS-X6624-FXS analog interface module.

Table B-2 RJ-21 Connector Pinouts (WS-X6224-FXS Analog Interface Module Only)

Port Number	Connector Pin Number	Signal	Port Number	Connector Pin Number	Signal
1	1	Ring Tip	13	13	Ring Tip
	26			38	
2	2	Ring Tip	14	14	Ring Tip
	27			39	
3	3	Ring Tip	15	15	Ring Tip
	28			40	
4	4	Ring Tip	16	16	Ring Tip
	29			41	
5	5	Ring Tip	17	17	Ring Tip
	30			42	
6	6	Ring Tip	18	18	Ring Tip
	31			43	
7	7	Ring Tip	19	19	Ring Tip
	32			44	
8	8	Ring Tip	20	20	Ring Tip
	33			45	

Table B-2 RJ-21 Connector Pinouts (WS-X6224-FXS Analog Interface Module Only) (continued)

Port Number	Connector Pin Number	Signal	Port Number	Connector Pin Number	Signal
9	9 34	Ring Tip	21	21 46	Ring Tip
10	10 35	Ring Tip	22	22 47	Ring Tip
11	11 36	Ring Tip	23	23 48	Ring Tip
12	12 37	Ring Tip	24	24 49	Ring Tip
—	—	—	—	25, 50, 51, 52	GND

RJ-45 Connector

The RJ-45 connector is used to connect a Category 3, Category 5, Category 5e, or Category 6 FTP or UTP cable from the external network to the module interface connector. (See Figure B-2.) Table B-3 lists the connector pinouts and signal names for a 10/100BASE-T crossover (MDI-X) cable. Figure B-3 shows a schematic of the 10/100BASE-T crossover cable. Table B-4 lists the connector pinouts and signal names for a 1000BASE-T crossover (MDI-X) cable. Figure B-4 shows a schematic of the 1000BASE-T crossover cable.



Caution

Category 5e and Category 6 cables can store high levels of static electricity because of the dielectric properties of the materials used in their construction. Always ground the cables (especially in new cable runs) to a suitable and safe earth ground before connecting them to the module.



Caution

To comply with GR-1089 intrabuilding, lightning-immunity requirements, you must use foil-twisted pair (FTP) cable that is properly grounded at both ends.

Inline power for IP Phones uses connector pins 1, 2, 3, and 6 in a Category 5, Category 5e, or Category 6 cable to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the IP Phone power travels over the same pairs of wires used to transmit the Ethernet signals. The IP Phone voltage is completely transparent to the Ethernet signals and does not interfere with their operation.

Figure B-2 RJ-45 Interface Cable Connector

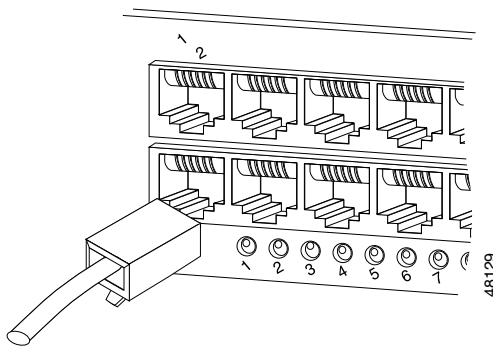


Table B-3 10/100BASE-T Crossover Cable Pinout (MDI-X)

Side 1 Pin (Signal)	Side 2 Pin (Signal)
1 (RD+)	3 (TD+)
2 (RD–)	6 (TD–)
3 (TD+)	1 (RD+)
6 (TD–)	2 (RD–)
4 (Not used)	4 (Not used)
5 (Not used)	5 (Not used)
7 (Not used)	7 (Not used)
8 (Not used)	8 (Not used)

Figure B-3 Twisted-Pair Crossover 10/100BASE-T Cable Schematic

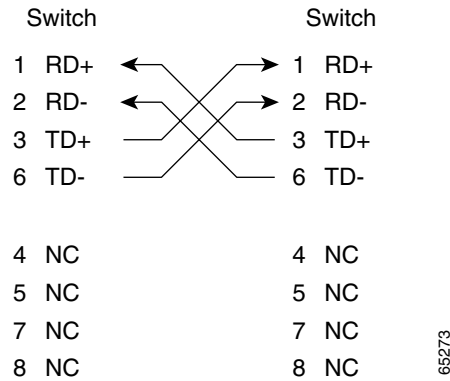
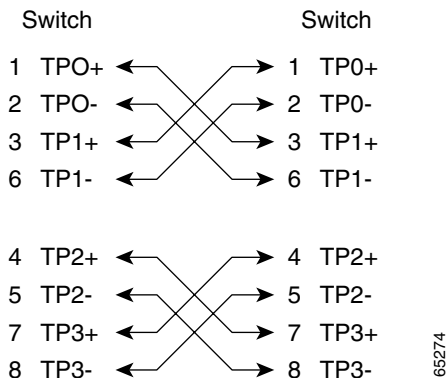


Table B-4 1000BASE-T Crossover Cable Pinout (MDI-X)

Side 1 Pin (Signal)	Side 2 Pin (Signal)
1 (TP0+)	3 (TP1+)
2 (TP0-)	6 (TP1-)
3 (TP1+)	1 (TP0+)
6 (TP1-)	2 (TP1-)
4 (TP2+)	7 (TP3+)
5 (TP2-)	8 (TP3-)
7 (TP3+)	4 (TP2+)
8 (TP3-)	5 (TP2-)

Figure B-4 Twisted-Pair Crossover 1000BASE-T Cable Schematic

Supervisor Engine Console Port Signals and Pinouts

The Catalyst 6500 series switch comes with an accessory kit that contains the cable and adapters you need to connect a console (an ASCII terminal or PC running terminal emulation software) or modem to the console port. The accessory kit includes these items:

- RJ-45-to-RJ-45 rollover cable
- RJ-45-to-DB-9 female DTE adapter (labeled “Terminal”)
- RJ-45-to-DB-25 female DTE adapter (labeled “Terminal”)
- RJ-45-to-DB-25 male DCE adapter (labeled “Modem”)

This is the same cable and adapters that ship with the Cisco 2500 series routers and other Cisco products.

CONSOLE PORT MODE Switch

**Note**

Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch. The switch is shipped in the *in* position.

The supervisor engine front-panel CONSOLE PORT MODE switch allows you to connect a terminal or modem to the console port as follows:

- Mode 1—Switch in the *in* position. Use this mode to connect a terminal to the console port using the RJ-45-to-RJ-45 rollover cable and DTE adapter (labeled “Terminal”).

You can also use this mode to connect a modem to the console port using the RJ-45-to-RJ-45 rollover cable and DCE adapter (labeled “Modem”).

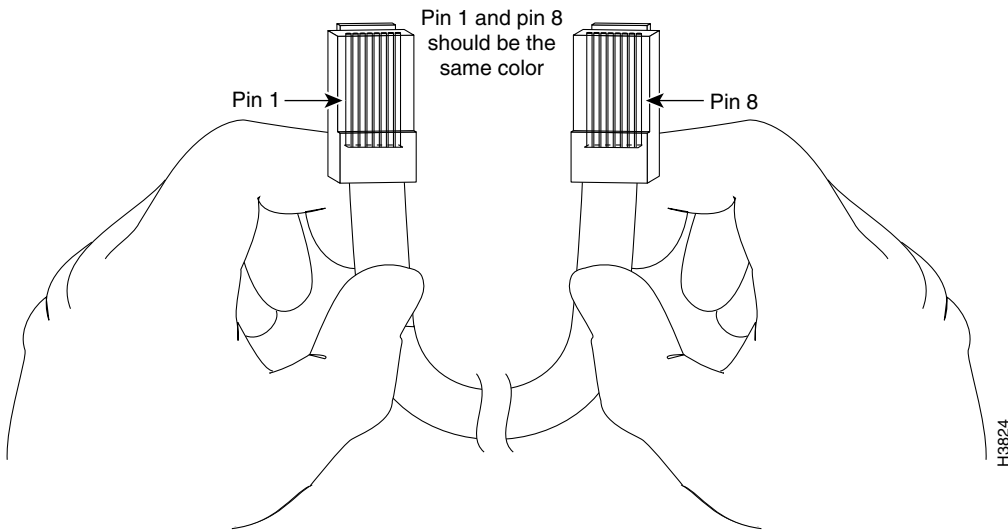
See the “Console Port Mode 1 Signaling and Pinouts” section on page B-10.

- Mode 2—Switch in the *out* position. Use this mode to connect a terminal to the console port using the Catalyst 5000 family Supervisor Engine III console cable and appropriate adapter for the terminal connection (cable and adapter are not provided).

See the “Console Port Mode 2 Signaling and Pinouts” section on page B-13.

Identifying a Rollover Cable

You can identify a rollover cable by comparing the two ends of the cable. Holding the cables side-by-side, with the tab at the back, the wire connected to the pin on the outside of the left plug should be the same color as the wire connected to the pin on the outside of the right plug. (See Figure B-5.) If your cable was purchased from Cisco Systems, pin 1 will be white on one connector, and pin 8 will be white on the other (a rollover cable reverses pins 1 and 8, 2 and 7, 3 and 6, and 4 and 5).

Figure B-5 Identifying a Rollover Cable

Console Port Mode 1 Signaling and Pinouts

This section provides the signaling and pinouts for the console port in mode 1 (CONSOLE PORT MODE switch in the *in* position).

DB-9 Adapter (for Connecting to a PC)

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-9 female DTE adapter (labeled “Terminal”) to connect the console port to a PC running terminal emulation software. Table B-5 lists the pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-9 female DTE adapter.

Table B-5 Port Mode 1: Console Port Signaling and Pinouts (DB-9 Adapter)

Console Port	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-9 Terminal Adapter	Console Device
Signal	RJ-45 Pin	RJ-45 Pin	DB-9 Pin	Signal
RTS	1 ¹	8	8	CTS
DTR	2	7	6	DSR
TxD	3	6	2	RxD
GND	4	5	5	GND
GND	5	4	5	GND
RxD	6	3	3	TxD
DSR	7	2	4	DTR
CTS	8 ¹	1	7	RTS

1. Pin 1 is connected internally to Pin 8.

DB-25 Adapter (for Connecting to a Terminal)

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-25 female DTE adapter (labeled “Terminal”) to connect the console port to a terminal. Table B-6 lists the pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-25 female DTE adapter.

Table B-6 Port Mode 1: Console Port Signaling and Pinouts (DB-25 Adapter)

Console Port	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-25 Terminal Adapter	Console Device
Signal	RJ-45 Pin	RJ-45 Pin	DB-25 Pin	Signal
RTS	1 ¹	8	5	CTS
DTR	2	7	6	DSR
TxD	3	6	3	RxD
GND	4	5	7	GND

Table B-6 Port Mode 1: Console Port Signaling and Pinouts (DB-25 Adapter) (continued)

Console Port	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-25 Terminal Adapter	Console Device
Signal	RJ-45 Pin	RJ-45 Pin	DB-25 Pin	Signal
GND	5	4	7	GND
RxD	6	3	2	TxD
DSR	7	3	20	DTR
CTS	8 ¹	1	4	RTS

1. Pin 1 is connected internally to Pin 8.

Modem Adapter

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-25 male DCE adapter (labeled “Modem”) to connect the console port to a modem. Table B-7 lists the pinouts for the asynchronous serial auxiliary port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-25 male DCE adapter.

Table B-7 Port Mode 1: Console Port Signaling and Pinouts (Modem Adapter)

Console Port	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-25 Modem Adapter	Modem
Signal	RJ-45 Pin	RJ-45 Pin	DB-25 Pin	Signal
RTS	1 ¹	8	4	RTS
DTR	2	7	20	DTR
TxD	3	6	3	TxD
GND	4	5	7	GND
GND	5	4	7	GND
RxD	6	3	2	RxD
DSR	7	3	8	DCD
CTS	8 ¹	1	5	CTS

1. Pin 1 is connected internally to Pin 8.

Console Port Mode 2 Signaling and Pinouts

This section provides the signaling and pinouts for the console port in mode 2 (console port mode switch in the *out* position). See Table B-8 for the pinouts.

Table B-8 Console Port Pinouts (Port Mode Switch Out)

Console Port	Console Device
Pin (signal)	Input/Output
1 (RTS) ¹	Output
2 (DTR)	Output
3 (RxD)	Input

Table B-8 Console Port Pinouts (Port Mode Switch Out) (continued)

Console Port	Console Device
4 (GND)	GND
5 (GND)	GND
6 (TxD)	Output
7 (DSR)	Input
8 (CTS) ¹	Input

1. Pin 1 is connected internally to Pin 8.

Fiber-Optic Connectors

This section describes the SC and MT-RJ fiber-optic connectors.

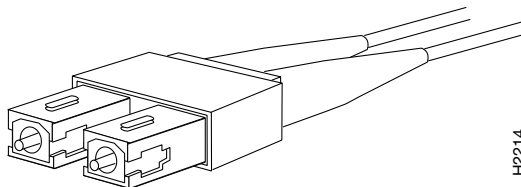
SC Connectors



Warning

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

The SC single-mode (fiber) connector is used to connect fiber-optic module ports with the external network. (See Figure B-6.)

Figure B-6 SC Optical Connector

Always make sure that you insert the connector completely into the socket. This action is especially important when you are making a connection between a module and a long distance (1.24 miles [2 kilometers]) or a suspected highly attenuated network. If the link LED does not light, try removing the network cable plug and reinserting it firmly into the module socket. It is possible that enough dirt or skin oils have accumulated on the plug faceplate (around the optical-fiber openings) to generate significant attenuation, reducing the optical power levels below threshold levels so that a link cannot be made.

**Caution**

Use extreme care when removing or installing connectors so that you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

For fiber-optic connector cleaning instructions, refer to the “Cleaning the Fiber-Optic Connectors” section on page B-17.

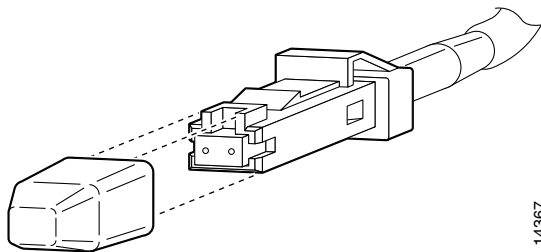
MT-RJ Connectors

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.
Statement 1051

The MT-RJ style connector is used on fiber-optic modules to increase port density. (See Figure B-7.)

Figure B-7 MT-RJ Optical Connector



When you are connecting MT-RJ cables to a module, make sure you firmly press the connector plug into the socket. The upper edge of the plug must snap into the upper front edge of the socket. You may or may not hear an audible click. Gently pull on the plug to confirm whether or not the plug is locked into the socket. To disconnect the plug from the socket, press down on the raised portion on top of the plug (releasing the latch). You should hear an audible click indicating that the latch has released. Carefully pull the plug out of the socket.

Always make sure that you insert the connector completely into the socket. This action is especially important when you are making a connection between a module and a long distance (1.24 miles [2 kilometers]) or a suspected highly attenuated network. If the link LED does not light, try removing the network cable plug and reinserting it firmly into the module socket. It is possible that enough dirt or skin oils have accumulated on the plug faceplate (around the optical-fiber openings) to generate significant attenuation, reducing the optical power levels below threshold levels so that a link cannot be made.

**Caution**

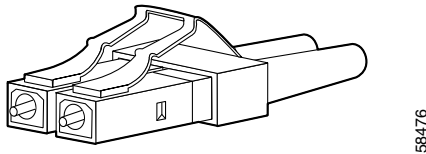
Use extreme care when removing or installing connectors so that you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

For fiber-optic connector cleaning instructions, refer to the “Cleaning the Fiber-Optic Connectors” section on page B-17.

When you disconnect the fiber-optic cable from the module, grip the body of the connector. Do not grip the connector jacket-sleeve. Gripping the sleeve can, over time, compromise the integrity of the fiber-optic cable termination in the MT-RJ connector.

LC Connectors

Small Form-Factor Pluggable (SFP) transceiver modules used on the Supervisor Engine 720 uplink ports use either MT-RJ connectors or LC connectors depending on the SFP vendor. Figure B-8 shows an LC connector.

Figure B-8 LC Fiber Optic Connector**Caution**

Use extreme care when removing or installing connectors so that you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Cleaning instructions for fiber-optic connectors is located in “Cleaning the Fiber-Optic Connectors” section on page B-17.

When you disconnect the fiber-optic cable from the module, grip the body of the connector. Do not grip the connector jacket-sleeve. Gripping the sleeve can, over time, compromise the integrity of the fiber-optic cable termination in the MT-RJ connector.

Cleaning the Fiber-Optic Connectors

Fiber-optic connectors are used to connect two fibers together. When these connectors are used in a communications system, proper connection is critical.

Fiber-optic connectors differ from electrical connectors or microwave connectors. In a fiber-optic system, light is transmitted through an extremely small fiber core. Because fiber cores are often 62.5 microns or less in diameter in MMF and 8.3 to 10 microns in SMF, dust particles and any contamination on the face of the fiber core can degrade the performance of the connector interface where the two cores meet. The connector must be precisely aligned, and the connector interface must be absolutely free of trapped contaminants.

**Caution**

Use extreme care when removing or installing connectors so that you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

To clean the fiber-optic connectors, use a CLETOP cassette cleaner (type A for SC connectors or type B for MT-RJ connectors) and follow the product instructions. If a CLETOP cassette cleaner is not available, follow these steps:

-
- Step 1** Gently wipe the ferrules and end-face surfaces of the connector with an alcohol pad. Be sure that the pad makes full contact with the end-face surfaces. Wait five seconds for the surfaces to dry and repeat.
- Step 2** Blow dry the connectors with canned, dry, oil-free, compressed air.
- Step 3** Use a magnifying glass or inspection microscope to inspect the ferrule. If contaminants are visible, repeat the cleaning procedure.
-

The connectors used inside the system have been cleaned by the manufacturer and connected to the adapters in the proper manner. The operation of the system should be error free if the customer provides clean connectors on the application side, follows the previous directions, and follows the listed guidelines:

- Clean the connectors using lens tissues before connecting to the adapters. Use pure alcohol to remove contamination.
- Do not clean the inside of the connector adapters.
- Do not use force or quick movements when connecting the fiber-optic connectors in the adapters.
- Cover the connector adapters to avoid contaminating the inside of the adapters while cleaning the chassis.
- Cover the connectors and adapters to avoid the inside of the adapters or the surface of the connectors from getting dirty when not using the connectors.



Note

If the surface is not clean or does not have an even shine, repeat the process using a fresh surface of the alcohol pad.



Numerics

1000BASE-LX/LH

- channel insertion loss (table) **2-7**
- transmission distances (table) **2-6**

1000BASE-SX

- channel insertion loss (table) **2-7**

1000BASE-SX GBIC

- transmission distances (table) **2-6**

1000BASE-T

- transmission distances (table) **2-6**

1000BASE-ZX

- channel insertion loss (table) **2-7**
- transmission distances (table) **2-6**

100BASE-FX

- optical characteristics (table) **2-5**

10BASE-FL

- optical characteristics (table) **2-4**

10 Gigabit Ethernet

- 5-dB attenuator requirement (caution) **2-7**
- optical characteristics (table) **2-9**
- optical transmission distance specifications (table) **2-8**

A

accessories kit, console port **3-15**

accessory kit, console port **B-8**

ACTIVE LED

ATM modules description (table) **1-52**

ACTIVE LEDs **1-12**

adapters

DB-25 **B-11**

DB-9 **B-10**

modem **B-12**

addresses

MAC **1-86**

physical interface **1-85**

ports **1-84**

ATM

LEDs **1-51**

modules **1-48 to 1-52**

optical specifications MMF (table) **2-3**

optical specifications SMF (table) **2-3**

attenuators, using with 1000BASE-ZX
GBIC **2-6**

audience **xi**

B

blank module carriers **3-3**
 boot Flash **1-7**

C

cables

ATM distance limitations **2-3**
 Category 3 maximum transmission distances
 (table) **2-4**
 Category 5 maximum transmission distances
 (table) **2-4**
 distance limitations
 description **2-1**
 Ethernet **2-4**
 Fast Ethernet **2-4**
 Gigabit Ethernet **2-6**

specifications **B-1**

cabling

console port **2-13**
 console ports **B-8**
 unconditioned laser source on SMF **2-11**

Catalyst 6006 switches

description **1-2**

Catalyst 6009 switches

description **1-2**

Catalyst 6503 switches

description **1-4**

Catalyst 6506 switches

description **1-4**

Catalyst 6509-NEB-A switches

description **1-4**

Catalyst 6509-NEB switches

description **1-4**

Catalyst 6509 switches

description **1-4**

Catalyst 6513 switch

description **1-4**

supervisor engine requirement (note) **1-4**

Category 3 UTP cables

maximum transmission distances (table) **2-4**

category 5e static electricity caution **B-5**

Category 5 UTP

maximum transmission distances (table) **2-4**

category 6 static electricity caution **B-5**

channel capacity

connection distances and **2-1**

channel insertion loss

GBICs (table) **2-7**

cleaning

guidelines **B-18**

commands

show module **3-20**

show port **1-86, 3-20**

write **3-12**

Communication Media Module

- description **1-75**
- E1 interface module front panel (figure) **1-79**
- front panel (figure) **1-76**
- interface modules **1-75**
- interface modules features (table) **1-77**
- LEDs (table) **1-78**
- T1 interface module front panel (figure) **1-79**
- connecting
 - modem **3-16**
 - terminal **3-15**
- connection distances **2-1**
- connectivity
 - checking **3-22**
- connectors
 - connector types **2-14**
 - port **2-14**
 - see specific types of connectors (for example, MT-RJ connectors)
- console port
 - accessories kit **3-15**
 - cable transmission distances **2-14**
 - connecting to **3-15**
 - description **1-13**
 - port mode switch **B-9**
 - signaling and pinouts
 - mode 1 **B-10**
 - mode 2 **B-13**

- console port mode switch
 - ATM modules **1-49, 1-50**
 - description **1-14**
 - Multilayer Switch Module **1-57**
 - pinouts for mode 1 DB-25 adapters **B-11**
 - pinouts for mode 1 DB-9 adapters **B-11**
 - signaling for mode 1 **B-9**
 - signaling for mode 2 **B-9**
- content switching modules
 - front panel (figure) **1-71**
 - LEDs **1-71**
- conventions **xii**

D

- DB-25 adapters
 - modem adapter pinout (table) **B-13**
 - pinouts (table) **B-11**
- DB-9 adapters
 - pinouts (table) **B-11**
- differential mode delay
 - See DMD
- distance limitations
 - ATM **2-3**
 - compared to laser transmission (figure) **2-12**
 - connections **2-1**
 - description **2-1**

Ethernet cables **2-4**

Fast Ethernet cables **2-4**

Gigabit Ethernet cables **2-6**

DMD

description **2-11**

IEEE 802.3z **2-11**

E

EEPROM **1-7, 1-86**

EIA/TIA-232 transmission speeds **2-14**

environmental monitoring **1-88**

environmental specifications (table) **A-2**

Ethernet

maximum transmission distances (table) **2-4**

Ethernet and Fast Ethernet maximum
transmission distances (table) **2-4**

Ethernet modules

WS-6024-10FL-MT **1-20**

WS-X6148-GE-TX **1-21**

WS-X6148-RJ21V **1-22**

WS-X6148-RJ45V **1-23**

WS-X6148V-GE-TX **1-21**

WS-X6248-RJ45 **1-25**

WS-X6548-GE-TX **1-31**

WS-X6548V-GE-TX **1-32**

excessive link spans **2-13**

F

fault tolerance **1-6**

fiber-optic

connectors **2-15**

connectors **2-15**

transmission **2-7**

fiber-optic cable

ATM **2-3**

channel capacity **2-1**

Ethernet **2-4**

Fast Ethernet **2-4**

Gigabit Ethernet **2-6**

filler plate, module **3-3**

Flash PC cards

installing and removing **3-19**

sizes **3-18**

write-protection switch **3-18**

FlexWAN module

speeds **1-52**

FlexWAN modules

front panel (figure) **1-54**

LEDs (table) **1-54**

MSFC **1-52**

PFC **1-52**

front panel features

console port **1-13**

LEDs **1-12**

PCMCIA slots **1-15**

port mode switches **1-14**

Reset buttons **1-13**

switch load meters **1-15**

uplink ports **1-15**

G

GBICs

channel insertion loss (table) **2-7**

connecting to **3-16**

connectors **2-5**

See also specific types of GBICs **2-18**

Gigabit Ethernet

DMD occurrences **2-11**

Gigabit Ethernet maximum transmission
distances **2-5**

Gigabit Ethernet modules **1-36**

Gigabit Interface Converters **2-18**

H

hot swapping

component hot swapping **1-7**

supervisor engines and modules **1-87**

I

IEEE, recommended signaling
requirements **2-1**

IEEE 802.3z **2-11**

installing

patch cord **2-10**

supervisor engine **3-2**

switching module **3-2**

Intrusion Detection System Module

description **1-68**

front panel (figure) **1-69**

hard disk LED **1-70**

LEDs (table) **1-70**

PCMCIA slot **1-70**

shutdown button **1-70**

L

laser transmission **2-12**

LEDs

ATM modules (table) **1-51**

description **1-12**

modules **1-47**

transmission **2-12**

LED transmission **2-12**

light pathways

See modes

LINK LED

ATM modules description (table) **1-52**

description (table) **1-48**

supervisor engine **1-13**

link spans, excessive **2-13**

LX/LH GBIC **2-9, 2-14**

M

MAC address

allocation **1-86**

description **1-84**

management **1-7**

memory components **1-7**

modem, connecting to **3-16**

modem adapter **B-12**

modes

fiber **2-11**

module functionality

hot swapping **1-87**

MAC address **1-84**

MAC address allocation **1-86**

physical interface addresses **1-85**

port

addresses **1-84**

modules

blank module carriers **3-3**

LED description **1-47**

supervisor engine module **1-86**

MSFCs

FlexWAN modules **1-52**

supervisor engine features **1-6**

MSM

features **1-54**

front panel (figure) **1-56**

status LED **1-56**

MT-RJ connectors

100BASE-FX **2-15**

description **B-15**

figure **B-15**

Multilayer Switch Feature Cards

See MSFCs

Multilayer Switch Module

See MSM

multimode fiber-optic cable

Ethernet and Fast Ethernet **2-4**

Gigabit Ethernet **2-6**

N

NAM

features **1-58**

Network Analysis Module

See NAM

NVRAM **1-7**

O

optical power specifications (table) **2-9**

organization **xii**

overfilled launch condition **2-12**

P
Packet-over-SONET

see POS

patch cord

configuration example **2-10**

differential mode delay **2-11**

installation **2-10**

installation, figure **2-11**

length **2-10**

using with LX/LH GBICs **2-9**

PCMCIA

See also Flash PC cards

PCMCIA Flash

Flash file system **1-7**

PCMCIA slots, description **1-15, 3-18**

PFC

FlexWAN modules **1-52**

PHONE LED

WS-X6148-RJ21V **1-23**

WS-X6148-RJ45V **1-24**

WS-X6348-RJ-21V **1-28**

WS-X6348-RJ-45 **1-29**

WS-X6348-RJ-45V **1-30**

PHONE LED description (table) **1-48**

physical interface addresses **1-85**

physical specifications (table) **A-2**

ping command **3-22**

pinging a host **3-22**

Policy Feature Cards

See PFCs

port

densities **2-16**

port addresses **1-84**

port mode switch

description **1-14**

mode 1 **B-10**

mode 2 **B-13**

use of **3-15, B-9**

post-installation **3-22**

power management **1-88**

PWR MGMT LEDs **1-12**

R

redundancy **1-6**

Regulatory Compliance and Safety
Information **xiv**

related documentation **xix**

required tools **3-2**

Reset button, description **1-13**

RJ-21 connectors

cable type restriction note **B-2**

RJ-45 connector, 10/100BASE-TX **2-14**

RJ-45 connectors

description **B-5**

figure **B-6**

rollover cable **B-9**

RX LED

ATM modules description (table) **1-51**

S

SC connector

description **B-14**

SC-type connector

GBIC interfaces **2-14**

show module command **3-20**

show port command **1-86, 3-20**

SHUTDOWN button

NAM front panel (figure) **1-62**

signaling requirements,
IEEE-recommended **2-1**

SIGNAL LED

ATM modules description (table) **1-52**

single mode fiber-optic cable **2-5**

software requirements **2-26**

specifications, environmental and physical
(table) **A-2**

STATUS LED **1-57**

ATM module description (table) **1-51**

Ethernet and gigabit Ethernet module
description (table) **1-47**

firewall service modules **1-65**

FlexWAN modules **1-54**

MSM module description (table) **1-57**

Supervisor Engine 1

console port **1-13**

console port mode switch **1-14**

Flash PC cards **3-17**

front panel features (figure) **1-11**

LEDs **1-12**

memory components **1-7**

Reset button **1-13**

STATUS LED **1-54, 1-57**

Supervisor Engine 2

references to Supervisor Engine 1 and
Supervisor Engine 2 (note) **1-2**

Supervisor Engine 720

chassis slot assignments **3-2**

Compact Flash and MicroDrive **3-19**

front panel (figure) **1-11**

installation restrictions **1-10**

LED descriptions **1-12**

uplink ports **1-16**

Supervisor Engine III

connecting a terminal **3-16**

supervisor engine module, slot numbers **1-86**

supervisor engine slot assignments (table) **3-3**

switches

feature descriptions (table) **1-6**

features supported **1-3, 1-4**

See also specific switches (for example,
Catalyst 6506 switches)

Switch Fabric Module 2

use in Catalyst 6513 switches **1-5**

Switch Fabric Modules

Catalyst 6500 series switches **1-5**

features **1-72, 1-73**

front panel (figure) **1-73, 1-74**

LCD display **1-73, 1-74**

redundancy and (note) **1-5**

slot assignments **1-5**

STATUS LED **1-73, 1-74**

Switch load meter **1-13**

SYSTEM LEDs **1-12**

T

terminal, connecting to **3-15**

tools

required for installation **3-2**

TX LED

ATM modules description (table) **1-51**

U

uplink ports

connecting to **3-16**

description **1-15**

V

verifying installation **3-20**

W

warnings

translations **xiv**

write command **3-12**

write-protection switch on Flash PC card **3-19**

WS-C6500-SFM

description **1-72**

front panel (figure) **1-73**

LCD display **1-73**

LEDs **1-73**

push button switches **1-73**

WS-G5483

transmission distances (table) **2-6**

WS-G5484

transmission distances (table) **2-6**

WS-G5486

transmission distances (table) **2-6**

WS-G5487

transmission distances (table) **2-6**

WS-G6483 OIM

optical power specifications (table) **2-9**

optical transmission specifications
(table) **2-8**

WS-G6488 OIM **1-42**

optical power specifications (table) **2-9**

optical transmission specifications
(table) **2-8**

WS-SVC-CMM

- 6-port E1 interface module **1-79**
- 6-port T1 interface module **1-79**
- description **1-75**
- front panel (figure) **1-76**
- interface module LEDs (table) **1-79**
- LEDs (table) **1-78**
- supported features (table) **1-77**

WS-SVC-FWM-1-K9

- description **1-63**
- front panel (figure) **1-65**
- LEDs **1-65**
- LEDs (table) **1-65**
- shutdown button **1-65**

WS-SVC-IPSEC-1

- description **1-66**
- front panel (figure) **1-66**
- LEDs (table) **1-68**

WS-SVC-NAM-1

- description **1-59**
- front panel (figure) **1-60**
- LEDs (table) **1-60**
- shutdown button **1-60**
- supported RMON groups **1-59**

WS-SVC-NAM-2

- description **1-61**
- front panel (figure) **1-62**
- LEDs (table) **1-62**
- RMON groups supported **1-61**

WS-X6024-10FL-MT

- description **1-20**
- front panel (figure) **1-20**
- LEDs **1-20**

WS-X6066-SLB-APC

- description **1-71**
- front panel (figure) **1-71**
- LEDs (table) **1-72**

WS-X6101-OC12-MMF

- console port mode switch **1-49**
- description **1-49**
- front panel (figure) **1-49**
- LEDs **1-49**

WS-X6101-OC12-SMF

- console port mode switch **1-50**
- description **1-50**
- front panel (figure) **1-50**
- LEDs **1-50**

WS-X6148-GE-TX

- description **1-21**
- front panel (figure) **1-21**
- LEDs **1-21**

WS-X6148-RJ21V

- description **1-22**
- front panel (figure) **1-23**
- inline power **1-22**
- LEDs **1-23**

WS-X6148-RJ45V

- description **1-23**
- front panel (figure) **1-24**
- inline power **1-23**
- LEDs **1-24**

WS-X6148V-GE-TX

- description **1-21**
- front panel (figure) **1-22**
- inline power **1-21**
- LEDs **1-22**

WS-X6182-2PA

- description **1-52**
- LEDs **1-53**
- supported WAN adapters (table) **1-53**

WS-X6224-100FX-MT

- description **1-24**
- front panel (figure) **1-24**
- LEDs **1-24**

WS-X6248A-TEL

- description **1-26**
- front panel (figure) **1-26**
- LEDs **1-26**

WS-X6248-RJ45

- description **1-25**
- front panel (figure) **1-25**
- LEDs **1-25**

- WS-X6248-TEL
 - description **1-25**
 - front panel (figure) **1-25**
 - LEDs **1-25**
- WS-X6302-MSM **1-54**
 - LEDs **1-56**
- Ws-X6302-MSM
 - front panel (figure) **1-56**
- WS-X6316-GE-TX
 - description **1-38**
 - front panel (figure) **1-38**
 - LEDs **1-38**
- WS-X6324-100FX-MM
 - description **1-26**
 - front panel (figure) **1-27**
 - LEDs **1-27**
- WS-X6324-100FX-SM
 - description **1-27**
 - front panel (figure) **1-27**
 - LEDs **1-27**
- WS-X6348-RJ-21V
 - description **1-28**
 - front panel (figure) **1-28**
 - LEDs **1-28**
- WS-X6348-RJ-45
 - description **1-29**
 - front panel (figure) **1-29**
 - LEDs **1-29**
- WS-X6348-RJ45V
 - description **1-30**
 - front panel (figure) **1-30**
 - LEDs **1-30**
- WS-X6380-NAM **1-58**
- WS-X6381-IDS
 - description **1-68**
 - front panel (figure) **1-69**
 - hard disk LED **1-70**
 - LEDs (table) **1-70**
 - PCMCIA slot **1-70**
 - shutdown button **1-70**
- WS-X6408A-GBIC
 - description **1-39**
 - front panel (figure) **1-39**
 - LEDs **1-39**
- WS-X6408-GBIC
 - description **1-38**
 - front panel (figure) **1-39**
 - LEDs **1-39**
- WS-X6416-GBIC
 - description **1-40**
 - front panel (figure) **1-40**
 - LEDs **1-40**
- WS-X6416-GE-MT
 - description **1-41**
 - front panel (figure) **1-41**
 - LEDs **1-41**

WS-X6500-SFM2

- description **1-73**
- front panel (figure) **1-74**
- LCD display **1-74**
- LEDs **1-74**
- push button switches **1-74**
- redundancy **1-74**

WS-X6501-10GEX4

- description **1-41**
- front panel (figure) **1-41**
- LEDs **1-41**
- optical transmission specifications
(table) **2-8**

WS-X6501-1-GEX4

- optical power specifications (table) **2-9**

WS-X6502-10GE

- description **1-42**
- Distributed Forwarding Card upgrade **1-42**
- front panel (figure) **1-42**
- LEDs **1-42**
- OIM support **1-42**

WS-X6516A-GBIC

- description **1-43**
- Distributed Forwarding Card upgrade **1-43**
- front panel (figure) **1-44**
- LEDs **1-44**

WS-X6516-GBIC

- description **1-42**
- Distributed Forwarding Card upgrade **1-43**
- front panel (figure) **1-43**
- LEDs **1-43**

WS-X6516-GE-TX

- description **1-44**
- Distributed Forwarding Card upgrade **1-44**
- front panel (figure) **1-44**
- LEDs **1-44**

WS-X6524-100FX-MM

- description **1-31**
- front panel (figure) **1-31**
- LEDs **1-31**

WS-X6548-GE-TX

- description **1-31, 1-35**
- front panel (figure) **1-32, 1-35**
- LEDs **1-32, 1-35**
- QoS port architecture **1-35**

WS-X6548-RJ-21

- description **1-33**
- front panel (figure) **1-33**
- LEDs **1-33**

WS-X6548-RJ-45

- description **1-34**
- front panel (figure) **1-34**
- LEDs **1-34**

WS-X6548V-GE-TX

- description **1-32**
- front panel (figure) **1-33**
- inline power **1-32**
- LEDs **1-33**

WS-X6608-E1 1-80**WS-X6608-T1**

- description **1-80**
- front panel (figure) **1-81**
- LEDs (table) **1-81**

WS-X6624-FXS

- description **1-82**
- front panel (figure) **1-83**
- LEDs (table) **1-83**

WS-X6704-10GE

- description **1-44**
- front panel (figure) **1-45**
- LEDs **1-45**
- QoS architecture **1-44**

WS-X6724-SFP

- description **1-45**
- front panel (figure) **1-45**
- LEDs **1-45**
- QoS architecture **1-45**

WS-X6816-GBIC

- description **1-46**
- front panel (figure) **1-46**
- installation restrictions **1-46**
- LEDs **1-47**